United Republic of Tanzania
President's Office, Regional Administration and Local Government (PO-RALG)
Dar es Salaam City Council (DCC)

THE PROJECT FOR REVISION OF DAR ES SALAAM URBAN TRANSPORT MASTER PLAN IN UNITED REPUBLIC OF TANZANIA

FINAL REPORT

VOLUME-2 : MASTER PLAN

JULY 2018

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

EIGHT-JAPAN ENGINEERING CONSULTANTS INC.
NIPPON KOEI CO., LTD.
CTI ENGINEERING INTERNATIONAL CO., LTD.
METROPOLITAN EXPRESSWAY COMPANY LTD.

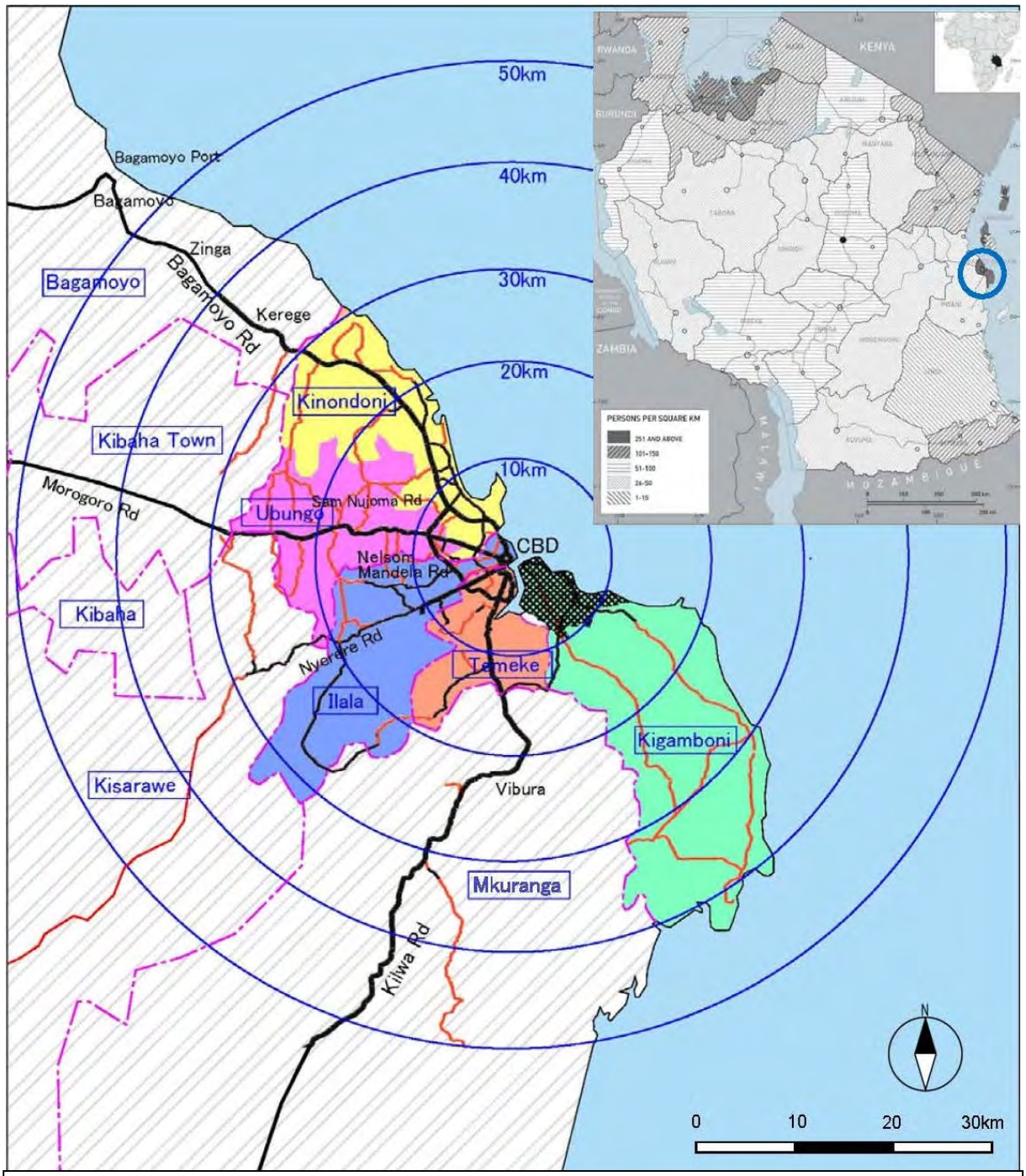
CURRENCY EXCHANGE RATE

(1) Tanzania Shillings (TZS) to Japanese Yen (JPY)
1TZS = 0.05 JPY (JICA Monthly Exchange Rate, December 2017)

(2) US Dollar (USD) to Japanese Yen (JPY)
1 USD =111.291 JPY (JICA Monthly Exchange Rate, December 2017)

(3) US Dollar (USD) to Tanzania Shillings (TZS)
1 USD =2,226 TZS (JICA Monthly Exchange Rate, December 2017)

Administrative Map of the City of Dar es Salaam



Population: 4.3 million in 2012.
Annual population growth rate from 2002 to 2012: 5.6%
Area: 1,393 km².
Population density: 3,087 person/km² in2012.
GDP Growth Rate: approximately 7% (2013-2016)
TANZANIA GDP: 2,131 thousand TZS/person
Dar es Salaam GDP: 3,228 thousand TZS/person

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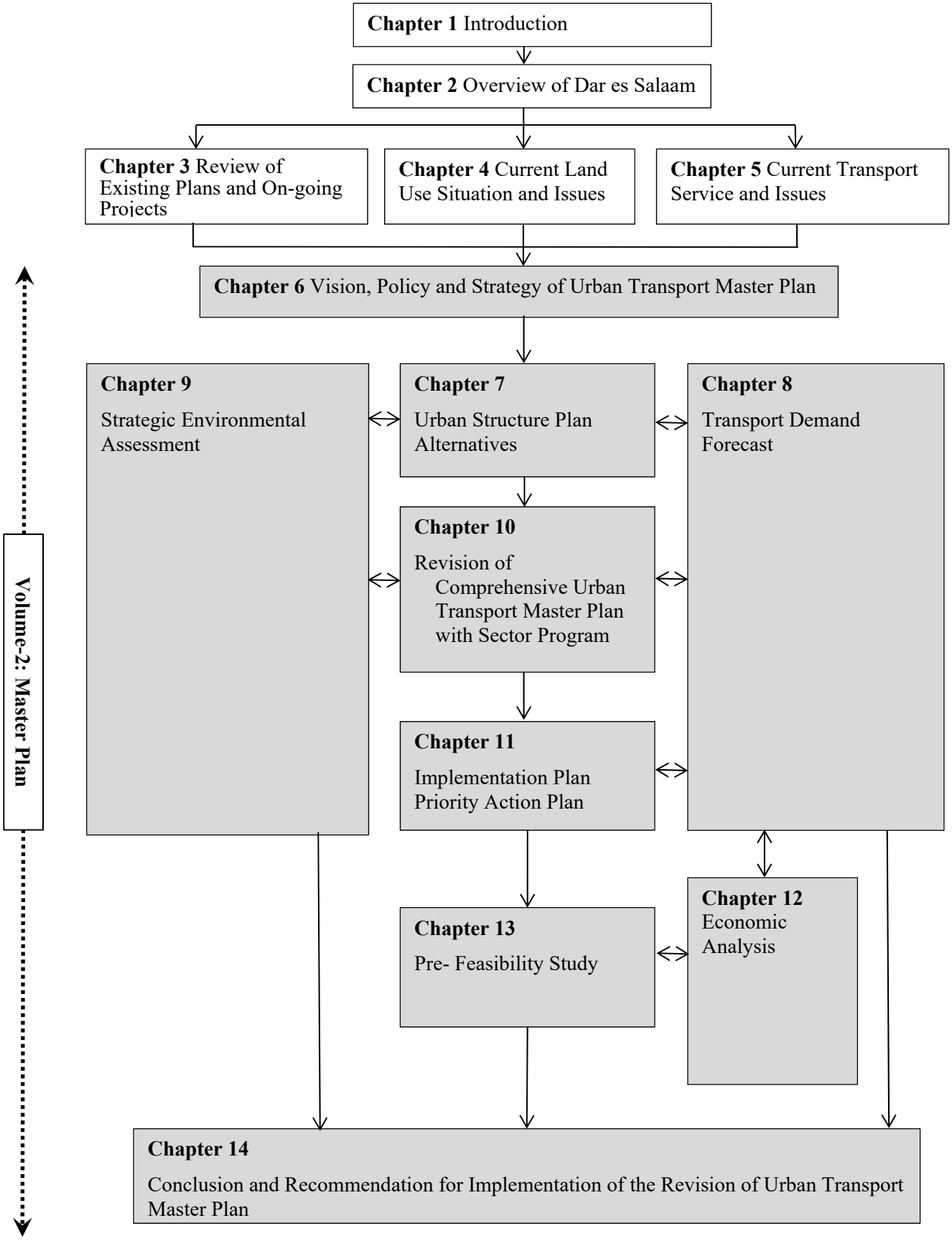

ABBREVIATIONS

AfDB	Africa Development Bank
AFC	Automatic Fare Collection
AOMCBP	Air Quality Monitoring Capacity Building Project
ARU	Ardhi University
ATC	Automatic Train Control
ATO	Automatic Train Operation
ATP	Auto Transformer Post
ATS	Automatic Train Stop
B/C	Cost Benefit Ratio
BOT	Build-Operate-Transfer
BRT	Bus Rapid Transit
C/P	Counterpart
CA	Contracting Authority
CAPEX	Capital Expenditure
CBD	Central Business District
CBTC	Communication-Based Train Control
CBTST	Capacity Building of Transport Sector in Tanzania
CCTV	Closed-circuit Television
CSG	Client Stakeholders Group
CMHI	China Merchants Holdings International
CPI	Consumer Price Index
CRIP	Country Risk Insurance Premium
CTC	Centralized Traffic Control
CUPID	Capacity Building Project for the Improvement of Dar es Salaam Transport
DART	Dar es Salaam Rapid Transit
DAWASA	Dar es Salaam Water and Sewerage Authority
DCC	Dar es Salaam City Council
DDM	Dodoma
DMDP	DSM Metropolitan Development Project
DMU	Diesel Multiple Units
DRC	Democratic Republic of the Congo
DSM	Dar es Salaam
DSMGP	DSM Marine Gateway Project
DSM-RAS	Dar es Salaam Regional Administrative Secretary
DUMP	Dar es Salaam Urban Master Plan
DUTA	Dar es Salaam Urban Transport Authority
EAC	East African Community
EBF	Equity Bank Finance
EHU	Equipment Hire Units
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EIS	Environmental Impact Statement
EMU	Electric Multiple Unit
EPZA	Export Processing Zone Authority
EU	European Union
FIRR	Financial Internal Rate of Return
FYDP I	First Five Year Development Plan
FYDP II	Second Five Year Development Plan
GDI	Gender Development Index

GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
GHG	Greenhouse Gas
GIS	Geographic Information System
GoJ	Government of Japan
GoK	Government of Korea
GoT	Government of Tanzania
GVM	Gross Vehicle Mass
HCM	Highway Capacity Manual
HIS	Household Interview Survey
HSSE	Health, Safety, Security and Environment
ICD	Inland Container Depot
IEE	Initial Environmental Examination
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
ISP	Interim Service Provider
ITS	Intelligent Transport System
JCC	Joint Coordination Committee
JICA	Japan International Cooperation Agency
JNIA	Julius Nyerere International Airport
JPY	Japanese Yen
JST	JICA Study Team
KDA	Kigamboni Development Authority
KSG	Key Stakeholders Group
LAPF	Local Government Authority Pension Fund
LDC	Least Developed Country
LGA	Local Government Authority
LRT	Light Rail Transit
LTPP	Long-Term Perspective Plan
M/M	Minutes of Meeting
M/P	Master Plan
MC	Municipal Council
MC	Motor Cycle
MDGs	Millennium Development Goals
MOFP	Ministry of Finance and Planning
MOHA	Ministry of Home Affairs
MOLHHSD	Ministry of Land, Housing and Human Settlements Development
MOWTC	Ministry of Works, Transport and Communication
MPI	Multidimensional Poverty Index
MRR	Middle Ring Road
MRT	Mass Rapid Transit
NBS	National Bureau of Statistics
NEAP	National Environmental Action Plan
NEMC	National Environment Management Council
NHC	National Housing Corporation
NIT	National Institute of Transport
NM	Nelson Mandela Road
NMT	Non-Motorized Transport
NSGRP	National Strategy for Growth and Reduction of Poverty
NSSF	National Social Security Fund
NPV	Net Present Value
O & M	Operation and Maintenance

OCC	Operation Control Center
OCS	Overhead Contact System
OD	Origin - Destination
ODA	Official Development Assistance
OPEX	Operating Expense
PCU	Passenger Car Unit
PDCA	Plan-Do-Check-Act
PHPDT	Peak Hour Peak Direction Traffic
PIM	Public Investment Management
PIRR	Project Internal Rate of Return
PO-RALG	President Office, Regional Administration and Local Government
PP	Public Procurement
PPE	Personal Protective Equipment
PPP	Public-Private Partnership
PS	Permanent Secretary
PT	Person Trip
R/D	Record of Discussions
RAHCO	Reli Assets Holding Company
RAIS	Road Accident Information System
RFB	Road Fund Board
RFP	Request for Proposal
RoRo	Roll-on/Roll-off
ROW	Right of Way
RP/SP	Revealed Preference/Stated Preference
RRB	Regional Road Board
RSS	Receiving Substation
SADC	Southern African Development Community
SADCC	Southern African Development Coordination Conference
SATTF	Southern Africa Trade and Transport Facilitation Project
SEA	Strategic Environmental Assessment
SEZ	Special Economic Zone
SGR	Standard Gauge Railway
SP	Service Provider
SPC	Special Purpose Company
SPV	Special Purpose Vehicle
SUMATRA	Surface and Marine Transport Regulatory Authority
SUTP	Strategic Transport
TAA	Tanzania Airport Authority
TAC	Technical Advisory Committee
TANESCO	Tanzania Electric Supply Company Limited
TANLAB	Tanzania Roads Agency Laboratory
TANROADS	Tanzania National Roads Agency
TARURA	Tanzania Rural and Urban Road Authority
TAT	Transporters Association of Tanzania
TATOA	Tanzania Truck Owners Association
TAZARA	Tanzania-Zambia Railway
TDV	Tanzania Development Vision
TEMESA	Tanzania Electrical, Mechanical and Electronics Service Agency
TEU	Twenty-foot Equivalent Unit
TIB	Tanzania Investment Bank
TICTS	Tanzania Internal Container Terminal Services Limited
TIF	Tax Increment Financing

TOD	Transit Oriented Development
TPA	Tanzania Port Authority
TPF	Tanzania Police Force
TPDC	Tanzania Petroleum Development Corporation
TRA	Tanzania Revenue Authority
TRC	Tanzania Railways Corporation
TRL	Tanzania Rail Limited
TSIP	Transport Sector Investment Programme
TTC	Travel Time Cost
TZS	Tanzanian Shilling
TSS	Traction Substation
TWG	Technical Working Group
UDA	Usafiri Dar es Salaam
UDA-RT	Usafiri salama Dar es Salaam Rapid Transit
UDSM	University of Dar es Salaam
UGB	Urban Growth Boundary
UNRA	Uganda National Road Authority
UTMP	(Dar es Salaam) Urban Transport Master Plan
VAT	Value Added Tax
VFM	Value for Money
VGF	Viability Gap Funding
VMS	Variable Message Sign
VOC	Vehicle Operation Cost
VPO	Vice President's Office
WB	World Bank
AfDB	Africa Development Bank
AFC	Automatic Fare Collection
ATC	Automatic Train Control
ATO	Automatic Train Operation
ATP	Auto Transformer Post
ATS	Automatic Train Stop
BOT	Build-Operate-Transfer
BRT	Bus Rapid Transit
C/P	Counterpart
CBD	Central Business District
CBTD	Communication-Based Train Control
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DART	Dar es Salaam Rapid Transit
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DSM	Dar es Salaam
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EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate Return
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EU	European Union
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GIS	Geographic Information System
HIS	Home Interview Survey
ICD	Inland Container Depot
IEE	Initial Environmental Examination
JICA	Japan International Cooperation Agency

LGA	Local Government Authority
LRT	Light Rail Transit
M/M	Minutes of Meeting
M/P	Master Plan
MOLHHSD	Ministry of Land, Housing and Human Settlements Development
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MRT	Mass Rapid Transit
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TARURA	Tanzania Rural and Urban Road Authority
TEMESA	Tanzania Electrical, Mechanical and Electronics Service Agency
TOD	Transport Oriented Development
TPA	Tanzania Port Authority
TPDC	Tanzania Petroleum Development Corporation
TRA	Tanzania Revenue Authority
TRC	Tanzania Railways Corporation
TRL	Tanzania Rail Limited
TZS	Tanzanian Shilling
TSS	Traction Substation
VPO	Vice President's Office

BASIC INDICATORS

1. Size (DSM)	• 1,393 km² (0.19 percent of the Tanzania mainland)
2. Population (DSM)	• Total Population: 4,364,541 (National Census, 2012) • Percentage share to the Population of the Country: 9.7% (2012) • Annual Growth Rate: 5.6% (2002 -2012)
3. Industry (National Trend)	• Share of Primary Sector: 12,149 billion TZS, 27.1% (MOFP, 2017) • Share of Secondary Sector: 9,375 billion TZS, 20.9%(MOFP, 2017) • Share of Tertiary Sector: 23,273 billion TZS, 52.0%(MOFP, 2017)
4. Economic Indicator (National and DSM)	• Country GDP: 47.3 billion USD (WB, 2016) • GDP per Capita: 877 USD (WB, 2016) • Annual Growth Rate: 7.17 % (IMF, 2016) • DSM GDP (GRDP): 17,640 billion TZS (MOFP, 2016) • Employment: 1,719,466 in DSM, 10% of total employment in the Country (17,916,156) • Consumer Price Index (CPI): 1.66 (IMF 2016, Base year 2010)
5. Social Indicator (National and DSM)	• Multidimensional Poverty Index (MPI): 26% in DSM, smallest proportion at the regional level in the Country (NBS, 2011) • Gender Development Index (GDI) in DSM: value 0.851 (HDI, 2014) • Literacy Rate at National Level: 80.4% (WB, 2015) • Life Expectancy at National Level : 64.90 (WB, 2015) • Birth Rate at National Level : 5.08 (WB, 2015)
6. Environmental Indicator (DSM)	• Major rivers; Mpiji River, Msimbazi River, Kizinga and Mzinga Rivers • Forest reserves and Game reserve: Pande Game Reserve, Pugu Forest Reserve, Kazimzumbwi Forest Reserve, Vikindu Forest Reserve, Ruvu North Forest Reserve, Ruvu South Forest Reserve
7. Transport Indicator (DSM)	• Vehicles Registration: 1,664,186 (2016, TRA/JICA-CUPID) • Annual Growth Rate of Registered Vehicle: 21% (2010-2014, TRA) • Road Traffic Volume Growth Rate: New Bagamoyo Rd 2.18, Old Bagamoyo Rd 2.00, Nelson Manderl Rd1.62, Nyerere Rd. 1.45 (2008-2014, TANROADS, JICA)
8. City Organization (DSM)	• Dar es Salaam City Council (DCC) coordinate 5 Municipalities (Ilala Municipal Council, Temeke Municipal Council, Kinondoni Municipal Council, Ubungo Municipal Council, Kigamboni Municipal Council) • Dar es Salaam Regional Administrative Secretary (DSM-RAS) supervises DCC and MCs

CHAPTER 6 VISION, POLICY AND STRATEGY OF URBAN TRANSPORT MASTER PLAN

6.1 Viewpoints of Revision of the Previous M/P

Based on the traffic survey and current status of transport in DSM, the following viewpoints are set up;

- **Population** : Population increase in DSM exceeded the estimation of the previous M/P. It was estimated 5.8million in 2030, however, in fact it is assumed to reach up to 5.8 million in 2017.Potential of future population growth shall be carefully estimated through the discussion with Tanzanian stakeholders, and data analysis referred to the various population projection methods. In addition, future framework in 2040 shall be developed based on the future appropriate population density and urbanised area.
- **Urban Structure** : Appropriate urban structure shall be reviewed based on the traffic survey results and current urban area expansion, urbanization speed and expansion of commuting area. Decentralization of the CBD functions shall be encouraged by on-going Satellite City projects and new Sub-centres set up based on the trend of on-going urban developments. M/P developed the future framework for the urban structure based on the discussion with MOLHHSD, who initiates DSM Master Plan, the trend of actual land use pattern, and to smoothly promote the Urban Transport Master Plan. To ensure coherency and the harmonization between M/P and the on-going DSM Master Plan by MOLHHSD is crucial. M/P team and MOLHHSD agreed on the reflection of future urban structure pattern of M/P into on-going DSM Master Plan.
- **Road and Public Transport Plan** : Traffic demand shall be forecasted from the long-term perspective based on the current trend of city expansion and population growth. Trend of the socio-economic, environmental change shall be also involved into the development of road plan and public transport plan.

Table 6.1.1 Viewpoints of Revision of M/P

Viewpoint of revision	Previous M/P in 2008	Revised M/P in 2018
Future Population and GDP growth rate	● Population:5.8 million in 2030 ● GDP annual growth rate: 5.5 % Between 2010 and 2030	● Population: reached 5.8 million in 2017 and estimated 12.0million in 2040 ● GDP annual average growth rate: 6.8 % between 2010 and 2016, estimated 6.0 % between 2017 and 2040
Urban Structure	● Poly-Centric Satellite Pattern ● (One CBD and Satellite cities) ● Urban Corridor Development ● (Radial corridors)	● Poly-Centric Satellite Pattern (One CBD, Four Sub-centers and Satellite cities) ● Palm and Fingers ● (Radial and Loop corridors)
Road Plan	● Focusing on the area within 10km away from CBD	● Focusing on the area within 30km away from CBD
Public Transport Plan	● Focusing on BRT	● Focusing on both Railway and BRT

6.2 Key Issues

The existing situation and key issues are as follows.

(1) Framework of Mega City

Existing Situation

- Population of DSM increased by 1.90 times or 6.6% of annual growth rate, from 3.0 million to 5.8 million in the past ten years between 2007 and 2017.
- Commuting area has expanded to 30km away from CBD, beyond the City boundary.
- Population density increased from 1,800 people/km^2 to 3,000 people/km^2.

Key Issues for the Future

- Population increase is estimated with more than 3.5% of annual growth rate (2017-2040), and will become around 10 million in 2030, around 12-15 million in 2040. Land use for future shall be examined with the availability of habitable space in DSM.
- Population density will exceed 10,000 persons/km^2, in case population increases up to 15 million in 2040. Overcrowding will lead several difficulties in the City life; water supply, energy consumption, natural environmental protection, congestion, pollution and crime.
- Appropriate framework shall be established to measure the issues, such as part of increasing population will be guided to accommodate in suburb, at 30km to 50km away from CBD.
- The details are described in the following section 6.3.

(2) Urban Structure, Land Use and Environment

Existing Situation

- Urban structure of DSM is characterized as a typical monocentric structure.
- Land use is not sufficiently controlled. Urban sprawl in suburbs is expanding; natural environment and flood prone areas are also developing for living and business.
- Air pollution, water pollution, noise, waste problems have been emerging rapidly in the urban area. Inefficient transport system also affects the air pollution and noise problem. Efficient energy use and low carbon footprint are big issues for transport in a Mega City.

Key Issues for the Future

- Establish sub-centres and satellite cities are required to decentralize CBD functions; business, shopping, education, hospital, cultural function shall be shared
- Intensive strategy for the urban corridor development shall be applied along Bagamoyo Road, Morogoro Road, Nyerere Road and Kilwa Road.
- Ensuring the areas for natural environment and disaster-prone is the key for land use. Good natural environment and disaster-prone areas should not be developed.
- Environmental friendly is essential for DSM transport plan. Improvement of the surroundings for NMT and public transport shall promote modal shift, result in the improvement of quality of life; reducing energy consumption, air pollution, noise, and traffic accidents.
- The details are described in Chapter 7.

(3) Transport Infrastructure

Issues on the performance of physical infrastructure are divided into three categories: mobility, accessibility and safety. Here, mobility is represented by capacity, travel speed, travel time and frequency of public transport mode. Accessibility is represented by distance to bus stop, transport terminal and trunk

road, density of road and public transport network. Safety is represented as risk of traffic accident and natural disaster such as flood.

(3)-1 Mobility

Existing Situation

- Heavy congestion in the major trunk roads in peak hours; travel speed around 10-15 km/h, although BRT runs at 20km/h.
- Travel time commuting to CBD is quite long; average time is more than one hour, 2.5 hours from the City boundary to CBD for 30km on the Bagamoyo Road.
- Railway provides once an hour operation in peak hours, whereas BRT provides frequent operation with 30 seconds interval.

Key Issues for the Future

- Improvement of capacity is related to number of lane, road width, type of intersection, vertical/horizontal aliment, capacity of vehicle, and so on.
- Improvement of speed and frequency of the public transport are required at the peak hours. Networking and collaboration of BRT and Railway (MRT) are necessary to meet the increasing demand of commuting.
- Sustainable modal shift strategy is required for the future Mega City.
- Networking transport infrastructure is required to maximize the efficiency; ring road or circular public transport line is required to integrate to the radial routes.
- Transport network shall be developed with the target at one hour reachable within the City, by rapid transport mode.

(3)-2 Accessibility

Existing Situation

- BRT and Railway operations are limited to meet the demand.
- Access to public transport modes is far to access in suburb.
- Low density of road network causes congestion, and generates longer travel time.
- Access to the Airport is highly dependent on the congestion of Nyerere Road; instability access-time especially on week-days.

Key Issues for the Future

- Rapid public transport network access to CBD, sub-centers, shopping centers and hospitals should be expanded to cover the whole highly populated urban areas.
- Higher density road network with at least more than 2 km / km^2 in suburbs is expected.
- Several access routes to Airport by not only private vehicles but also public transport should be provided in short-term so that Dar es Salaam would become a leading global Mega City in the East Africa Region.
- As far as accessibility to airport and sea port is concerned, express way and rapid public transport services from Tanzania as a whole are expected.

(3)-3 Safety

Existing Situation

- Traffic accidents have been increasing due to traffic congestion, poor traffic signals at the intersections, bad manner of traffic rules, illegal parking, etc.
- Floods often happen during the rainy season due to poor drainage systems and pavement

deterioration.

- Pavement deterioration on heavy traffic routes, especially nearby DSM port.

Key Issues for the Future

- Traffic management measure for safety is necessary to reduce the traffic accidents especially for children.
- Flood disasters should be prevented through appropriate road asset management as the enhancement of vulnerability of infrastructure including drainage and pavement.
- Pavement management should be implemented flexibly according to road classification.
- Emergency transport services, such as ambulances and fire fighting vehicles, should be operated more systematically by ICT and traffic control centre.

(4) Transport Operation

Issues on the level of transport service focusing on operation aspect are divided into three categories: punctuality, affordability and comfortability. Here, punctuality is represented by reliable/accurate operation time as scheduled. Affordability is represented by appropriate level of fare of public transport. Comfortability is represented by acceptable crowded condition, barrier free, people friendly service by public transport and acceptable road congestion level.

(4)-1 Punctuality

Existing Situation

- Due to instability of travel time, people's behavior becomes unpunctual. It will affect economic activities.
- There is no enough information on the travel time for car users; traffic congestion, accidents, restriction, and special operation on demand.

Key Issues for the Future

- BRT and railway are possible to provide reliable and punctual transport service.
- Reliable transport system should be expanded for the whole City, focusing on the urban axis or corridors of Bagamoyo Road, Morogoro Road, Nyerere Road, Kilwa Road and Kigamboni.
- Improvement of transportation punctuality shall bring positive impact on economic efficiency, and promote modal shift.
- Improvement of traffic management by intelligent management system is required. Travel information to support "Smart Mobility" shall improve the alternative selection of route, destination and transport mode.

(4)-2 Affordability

Existing Situation

- BRT and railway provide reasonable fare for the passengers. Ridership is steadily increasing, also due to fare affordability. Based on the result of interview survey, people are sensitive for the fare level of the public transport.
- The discount fare for Children and students is around 50%.

Key Issues for the Future

- Affordable fare setting is important for all users, especially for children, students and lower income people. It will encourage the modal shift.
- From the finance balance of the transport agencies, fare setting for the public transport

should be considered with the availability of the subsidies.

- Discount fare setting shall be considered with the trend of DSM; addition to current discount for children and students, further consideration for elderly, disabled people, and regular users like commuters in future.

(4)-3 Comfortability

Existing Situation

- BRT and railway have succeeded attracting passengers; however, there are issues of overcrowding. Barrier-Free facilities for vertical movement are not found at any railway stations. BRT provides slope at stations, and low-floor buses. No elevators or escalators currently exist at both railway and BRT stations so far and air condition equipment has not yet been introduced.
- Railway has no priority seats for elders, pregnant women, children and disabled, though BRT provides priority seats.
- Very low speed less than 15km/h on the road in peak hours is not acceptable for drivers. For example, such low level of travel speed is observed as many sections on Bagamoyo road.

Key Issues for the Future

- Crowding should be controlled lower than 150% by integration of railway, BRT, and Feeder bus service.
- Barrier-Free facilities and low or flat-floor buses should be installed for user-friendly at the major transport terminals.
- Public transport should have priority seats for elderly, pregnant women, children and disabled people.
- Road congestion in peak hours is seen as one of the most urgent issues. Traffic management system is expected to install into the highly congested area inside Nelson Mandela road.

(5) Implementation of M/P

There are many issues regarding implementation of M/P. Here, the issues are focused on three: management, integration and flexibility. PDCA are the basic procedure for management cycle. There are many public/private sectors and associated stakeholders involved in PDCA cycle of M/P. Therefore, the management are relating to organization or management body, ownership, coordination of sectors and stakeholders. In addition, M/P usually suggests a variety of projects with huge amount of investment. An effective integration of sector plans is required to conduct the projects efficiently. The integration can lead to an efficient demarcation and saving investments. Furthermore, M/P deals with a long term usually like 20 years. Tanzania is a developing country, so the population and economy of Dar es Salaam and Tanzania are assumed to be continuously increasing after 2040. In addition, the following 20 years are seen as a revolution period of transport technology. Therefore, the M/P must pay attention to flexibility to respond to changeable demand in quality and quantity.

(5)-1 Management

Existing Situation

- Previous M/P had faced several difficulties in its ownership and implement procedure. It had happened due to lack of clarification, demarcation, and harmonized function among the multi-level stakeholders.
- Public transport service supports basic needs of people living in DSM. Not yet introduced

traffic demand management system (TDM) in DSM.

- Public transport sector is often supported by subsidies for its operation and management.

Key Issues for the Future

- Simple and manageable approach by PDCA cycle shall be introduced for M/P implementation. Clarifying the ownership, demarcating responsibility of stakeholders is crucial.
- Establishment of coordination and harmonization board among stakeholders is urgently required.
- Public-Private partnership is essential to improve efficiency and effectiveness of public transport services TOD.
- Based on the appropriate investment plan, data-collection-system at the traffic control centre should be established in short term.

(5)-2 Integration

Existing Situation

- Urban structure or land use plan, road and public transport network plans have not been integrated. The reasons are; new comprehensive DSM Master Plan has not yet completed since 1979, and numbers of stakeholders conducts their own projects separately.
- Coordination board for managing urban transport system, proposed as DUTA, has not yet established.

Key Issues for the Future

- Urban structure, land use, road network, public transport network and traffic management plan should be integrated, synchronized and collaborated for maximize the impact of M/P implementation, under an appropriate ownership and management body.
- Urban structure plan which is suggested in M/P should be reflected to new DSM Master Plan and other related plans.
- Appropriate integrated monitoring system should be established to ensure the progress of M/P implementation.

(5)-3 Flexibility

Existing Situation

- Traffic demand in DSM would continuously increase after 2040, based on the population forecast in Tanzania.
- In the past ten years, population increased by 1.90 times (6.6% of annual growth rate), number of privately owned cars increased by 2.44 times (9.3% of annual growth rate), and total trip generation increased by 3.05 times (11.8% of annual growth rate).
- Although BRT and railway have effectively begun to operate, and roads have been improved, the contributions are not enough to meet the rapid demand increase in aspect of mobility, accessibility, safety, punctuality and comfortability.
- Flexible measures should be considered to adjust the demand change, caused by population growth, traffic demand, and financial resource.

Key Issues for the Future

- Traffic demand in DSM is forecasted increasing steadily, due to population and economic growth more than past ten years. Annual population growth is estimated by 3.2% (2017-2040), DSM becomes one of the Mega Cities in around 2030.

- Mass Rapid Transit systems (MRT), such as BRT and railway should be installed to sustain the efficient transport system in DSM.
- Efficient investment shall be required to implement the integrated sector plans.
- Flexibility is important to meet the changeable demand increase for public transport system, based on the lessons learned from several experiences of Mega Cities, such as Bangkok, Jakarta and Manila in Southeast Asia.
- Flexibility is crucial also for the project management and implementation. In road traffic, 66% of total traffic volume flow into CBD in the morning peak hours at the trunk roads in DSM. Concentration shall be solved through the flexible lane operation; four lane carriageways toward CBD, and two-lane carriageways toward suburbs in the morning peak hours. For public transport, starting from a small number of train coaches is required to avoid excessive initial investment. These are the examples of the flexible countermeasures for the project implementations.

6.2.1 Population Framework (Night Time)

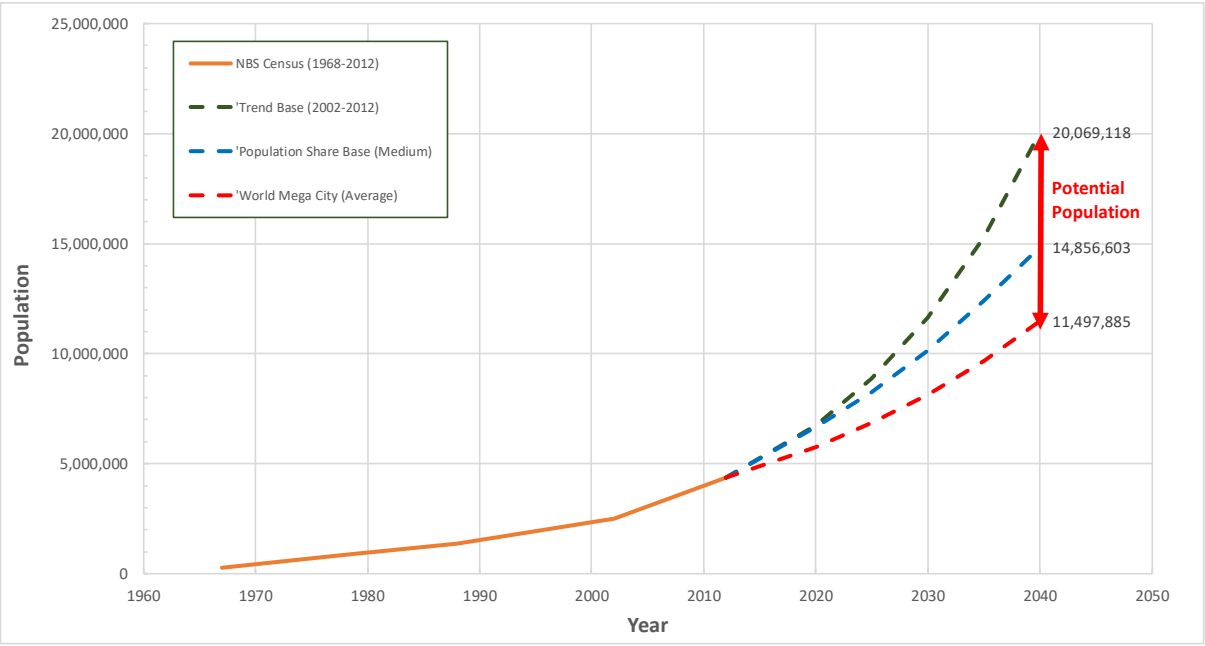
Population of Dar es Salaam (DSM) in 2012 was 4,364,561. National Bureau Statistics (NBS) estimated that population of DSM in 2017 is 5,781,557. Actual population has grown higher than population growth projected in the current 2008 MP. Annual population growth rate between 2002 and 2012 was 5.6%.

Population framework shows a planning target and is a base of future population distribution, future land use plan, and traffic demand forecast. As of February 2018, NBS regarded as the most reliable authority for population projection, has not yet projected future population in 2030 and 2040. How to project the future population and set the population framework without the population projection by NBS is an issue for setting population framework in the study.

The following policies to tackle the issue were applied.

- Reliable data is used.
  - Past National Population and Housing Census by NBS
  - World Population Prospect (The 2017 revision) by United Nations
  - World Urbanization Prospects (The 2014 Revision) by United Nations
- The following methods are applied to project population mainly based on past trends.
- Future population is also projected by examining capacities of suitable lands for development

By applying the above policies, potential population in DSM will range from 11,500,000 to 20,000,000 in 2040. JST tentatively assumes that it would be around 10,000,000 in 2030 and 15,000,000 in 2040. The annual growth rate is assumed to be approximately 4.5%. Figure 6.2.1 shows the result of population projection.



Source: JST projected based on Past National Population and Housing Census by NBS, World Population Prospect (The 2017 revision) by United Nations, World Urbanization Prospects (The 2014 Revision) by United Nations

Figure 6.2.1 Results of Population Projection up to 2040

The recent population growth trend showing high growth rate can be seen at the urban fringe of DSM. JST assumed that the population of DSM would spill over from the DSM administrative boundary to Pwani Region along the main corridors. JST assumed that 3,000,000 populations out of 15,000,000 populations will spill over to Pwani Region. As such, it is estimated that planning population in 2040 is 12,000,000 and planning population density in 2040 is 8,615 persons/km^2. The recent population trend of DSM and spill-over scenario will be mentioned in sub-chapter 8.1 of this report.

Table 6.2.1 Population Framework of DSM up to 2040

Year	2017	2020	2030	2040
Population (night-time)	5,781,557	6,359,316	8,735,662	12,000,000
Population Density (persons/km^2)	4,150	4,565	6,271	8,615

Source: JST

The projection method is summarized in Table 6.2.2. Data of past National Population and Housing Census by NBS were used for all methods. World Population Prospect (The 2015 revision) by United Nations was referred for "Population Share" method. World Urbanization Prospects (The 2014 Revision) by United Nations was referred for "Trend of World Mega Cities".

Table 6.2.2 Population Projection Method Applied in the Study

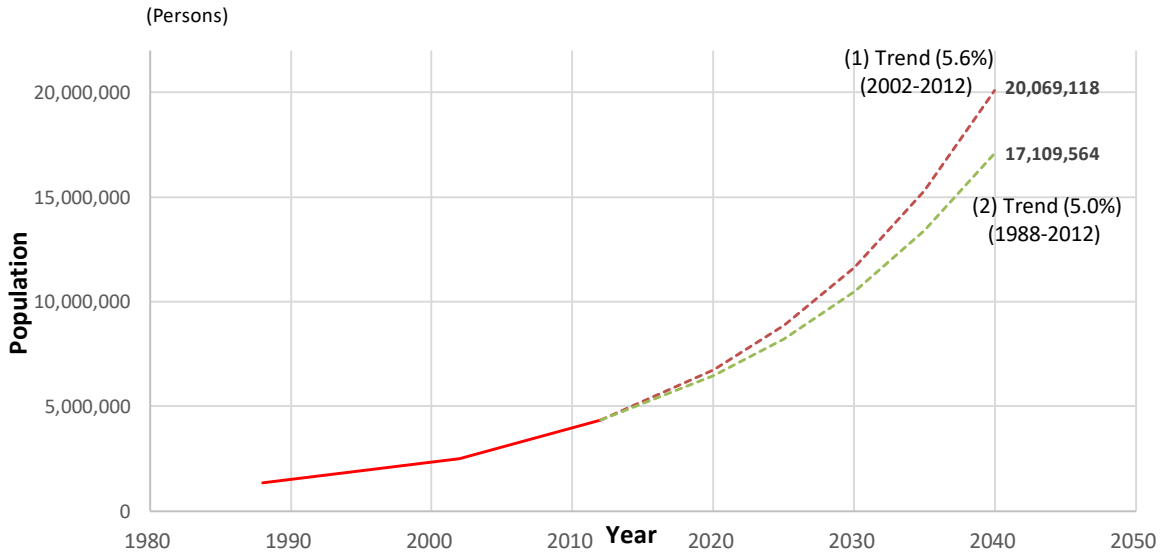
Projection Method	Summary
Past Trend	Annual population growth rates of DSM from 2002 to 2012 and from 1988 to 2012 are applied
Population Share	Future trend of population share of DSM to Tanzania is estimated by making correlation formula. Then, population projection of Tanzania by UN is multiplied by future population share of DSM to Tanzania.
Trend of World Mega Cities	Past annual population growth rates of 15 world mega cities when their population went up from about 5 million to 10 million are calculated. Highest rate, average rate, and lowest rate are applied.
Capacity of available land	Appropriate population estimated from the viewpoint of suitable land area and population density meeting planning standard.

Source: JST

Projection by each method is delineated in (2) to (4) below. Item of (5) examines the impact of the shift of the government function from DSM to Dodoma.

(2) Past Trend Method

Annual population growth rates of DSM from 2002 to 2012 and from 1988 to 2012 were applied in the population projection. The annual population growth rate of DSM from 2002 to 2012 was 5.6%, and the rate of DSM from 1988 to 2012 was 5.0%. JST assumes two cases: i) population will grow with the annual population growth rate of 5.6% from 2012 to 2040 by following the trend between 2002 and 2012, and ii) population will grow with the annual population growth rate of 5.0% from 2012 to 2040 by following the trend between 1988 and 2012. As shown in Figure 6.2.2, population in 2040 will be about 20 million if population will grow by following the population trend between 2002 and 2012 and will be about 17 million if population will grow by following the population trend between 1988 and 2012.



	2012	2020	2030	2040	Annual Growth Rate
Trend (2002-2012)	4,364,541	6,749,163	11,638,288	20,069,118	5.6%
Trend (1988-2012)		6,448,415	10,503,788	17,109,564	5.0%

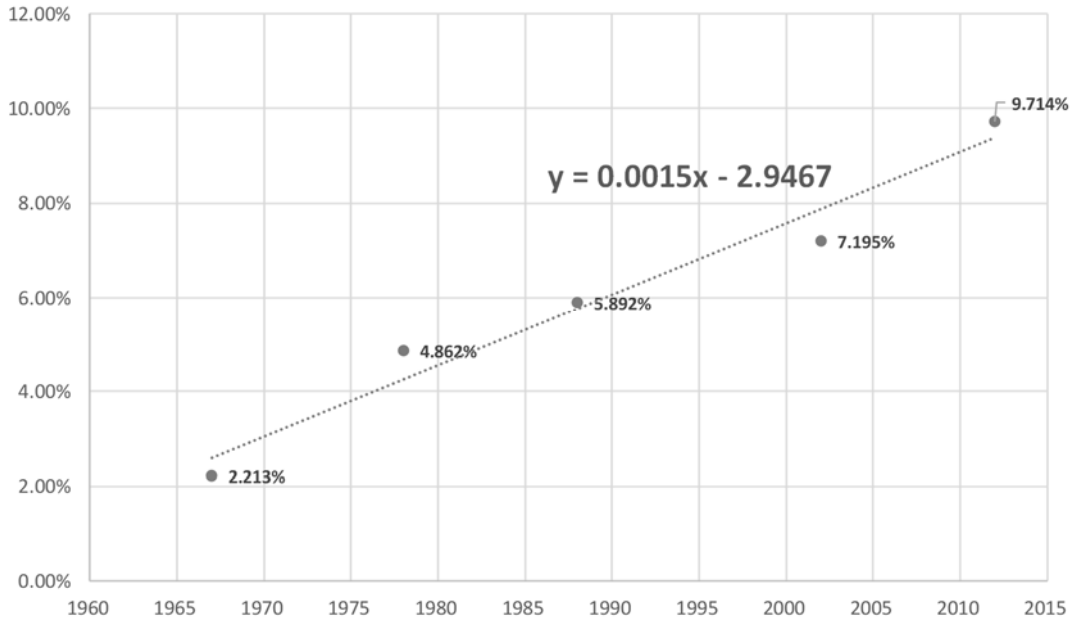
Source: JST based on National Population and Housing Census 1988, 2002, and 2012by NBS

Figure 6.2.2 Population Projection for DSM by Past Trend Method

(3) Population Share Method

Future trend of population share of DSM to Tanzania is estimated by making correlation formula. Then, population projection of Tanzania in World Population Prospect (The revision of 2017) by United Nations is multiplied by future population share of DSM to Tanzania.

The share of DSM population to Tanzania population was 2.2% in 1968. The share has increased to 7.2% in 2002 and 9.7% in 2012. Figure 6.2.3 shows the relation between year and the share of DSM population to Tanzania population.



Source: JST based on National Population and Housing Census 1968, 1978, 1988, 2002, and 2012 by NBS

Figure 6.2.3 Time Series Change of Population Share of DSM to Tanzania Population

Approximation formula showing the relation was developed based on the past population share. JST assumed that the population share of DSM population to Tanzania population will increase by following the formula after 2012. Table 6.2.3 shows the estimated share in 2020, 2025, 2030, 2035, and 2040, obtained by applying the formula.

$$Y = 0.0015X - 2.9467$$

Where, Y: share of DSM population to Tanzania population, X: year

Table 6.2.3 Estimated Share of DSM Population to Tanzania Population up to 2040

Year (X)	2020	2025	2030	2035	2040
Estimated Share (Y)	10.600%	11.356%	12.111%	12.867%	13.622%

Source: JST

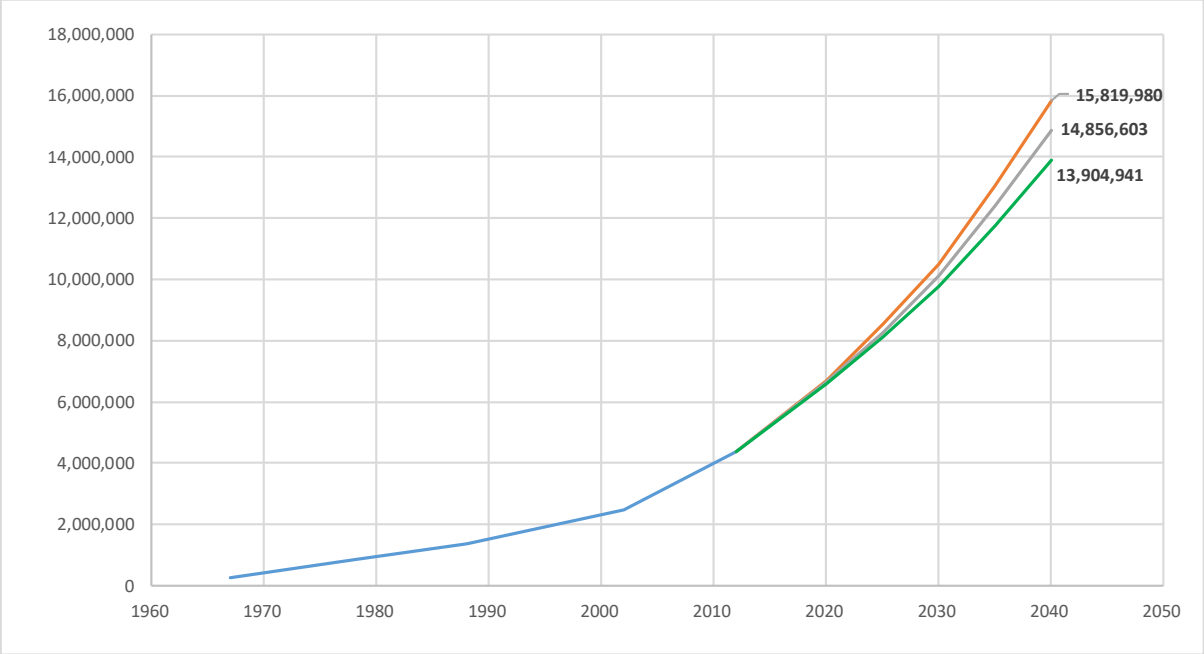
Estimated population of DSM for the target year can be obtained by multiplying estimated share and population in Tanzania for the target year. World Population Prospect (The 2017 revision) by United Nations was referred to the estimated data of population in Tanzania in 2020, 2030, and 2040. The estimated population in 2025 is the average of the estimated population in 2020 and 2030. The estimated population in 2035 is the average of the estimated population in 2030 and 2040. The prospect has population projections for three cases: i) high variant, ii) medium variant, and iii) low variant.

Table 6.2.4 and Figure 6.2.4 show the population projection of DSM by Population Share Method. Population of DSM in 2040 will be about 15.8 million for high variant case, about 14.9 million for medium variant case, and about 13.9 million for low variant case.

Table 6.2.4 Population Projection of DSM by Population Share Method

Year	Estimated Share	High variant		Medium variant		Low variant	
		Tanzania Pop.	DSM Pop.	Tanzania Pop.	DSM Pop.	Tanzania Pop.	DSM Pop.
2020	10.600%	63,305,000	6,710,260	62,775,000	6,654,080	62,244,000	6,597,795
2025	11.356%	75,001,000	8,516,753	72,681,000	8,253,305	71,476,000	8,116,471
2030	12.111%	86,697,000	10,500,004	83,702,000	10,137,275	80,708,000	9,774,668
2035	12.867%	101,414,500	13,048,782	96,381,000	12,401,133	91,391,000	11,759,080
2040	13.622%	116,132,000	15,819,980	109,060,000	14,856,603	102,074,000	13,904,941

Source: JST based on World Population Prospect (The revision of 2015) by United Nations



Source: JST based on World Population Prospect (The revision of 2017) by United Nations

Figure 6.2.4 Population Projection for DSM by Population Share Method

(4) Trend of World Mega City Method

World Urbanization Prospects (The 2014 Revision) by United Nations lists 35 cities with 5 million inhabitants or more in 2014. JST selected 15 cities by excluding cities in developed countries and cities with more than 20 million inhabitants and less than 10 million inhabitants.

Table 6.2.5 shows the list of the 15 selected cities. All selected cities have population of more than 10 million. A city of more than 10 million populations is defined as “Mega City”.

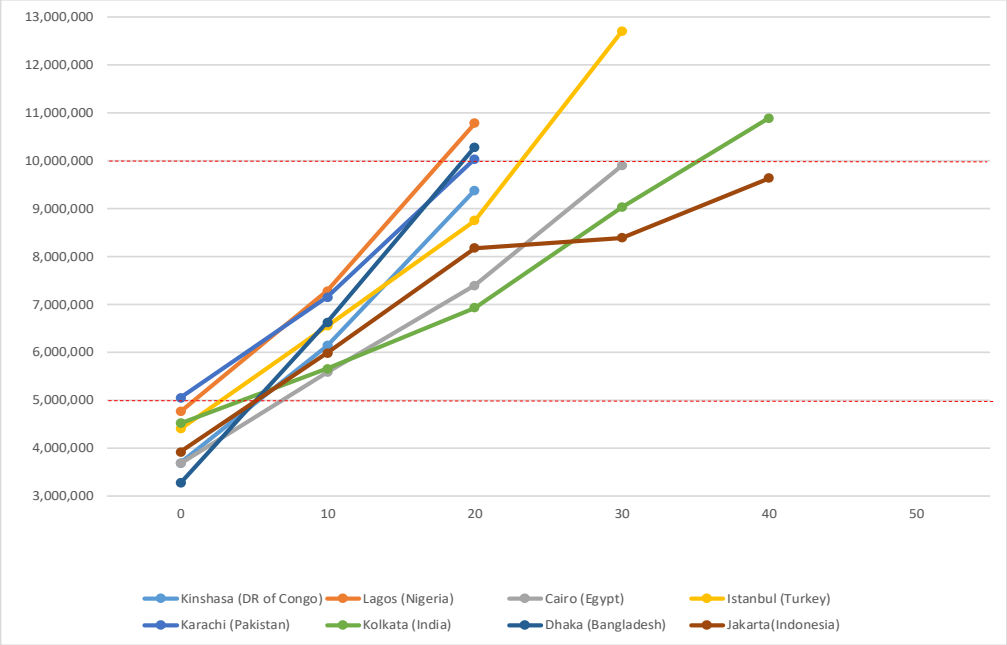
Table 6.2.5 List of 15 Selected Mega City

No.	Name of City, Country	Population (million) as of 2014
1	Cairo, Egypt	18.4
2	Dhaka, Bangladesh	17.0
3	Karachi, Pakistan	16.1
4	Buenos Aires, Argentina	15.0
5	Kolkata, India	14.8

6	Istanbul, Turkey	14.0
7	Chongqing China	12.9
8	Rio de Janeiro, Brazil	12.8
9	Manila, Philippines	12.7
10	Lagos, Nigeria	12.6
11	Guangzhou, China	11.8
12	Kinshasa, DR. of Congo	11.1
13	Tianjin, China	10.9
14	Shenzhen, China	10.7
15	Jakarta, Indonesia	10.2

Source: World Urbanization Prospects (The 2014 Revision) by United Nations

Figure 6.2.5 shows the population growth of eight cities out of 15 cities. To make the figure simpler, the population growth of seven cities out of 15 cities were not shown in the figure. Populations of Lagos, Karachi, and Dhaka had increased from about 5 million to 10 million in 20 years. It took about 30 years for Cairo and 40 years for Kolkata and Jakarta to shift from about 5 million to 10 million.

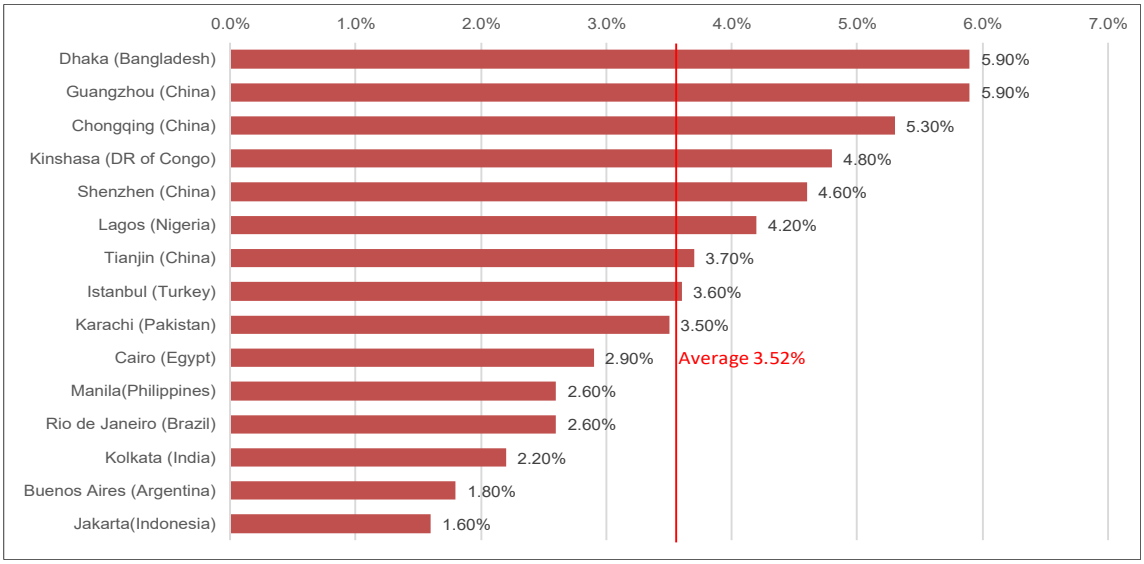


Source: JST calculated based on World Urbanization Prospects (The 2014 Revision) by United Nations

Figure 6.2.5 Number of Years for Population to Increase from 5 million to 10 million

JST calculates past annual population growth rate of the 15 cities when their population had increased from about 5 million to 10 million by using data of World Urbanization Prospects (The 2014 Revision) by United Nations, as shown in Figure 6.2.6. The annual population growth rates of Dhaka and Guangzhou are 5.90% and are the highest. The rate of Jakarta is 1.60% and is the lowest. The average rate of 15 cities is 3.52%, so the rates for Karachi and Istanbul are close to the average. For the population projection of DSM, the following three cases were assumed.

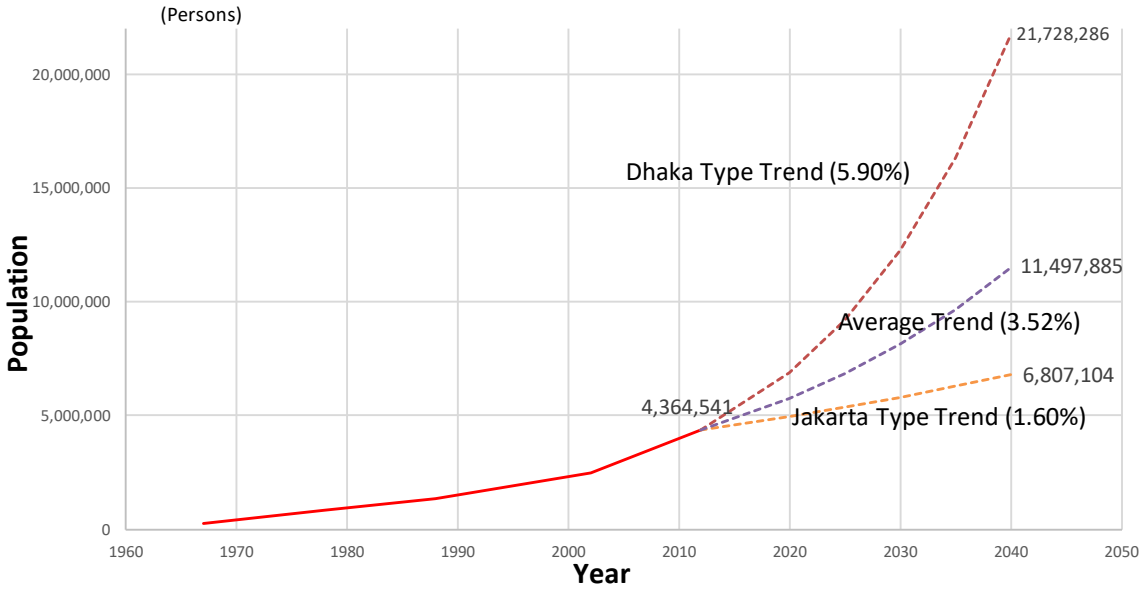
- High Case: 5.90 % (Dhaka and Guangzhou)
- Low Case: 1.60% (Jakarta)
- Average Case: 3.52%



Source: JST calculated based on World Urbanization Prospects (The 2014 Revision) by United Nations

Figure 6.2.6 Annual Population Growth Rate of 15 Selected Mega Cities

JST projected population of DSM as shown in Figure 6.2.7. If high case is assumed, the population of DSM in 2040 will be 21.7 million. The population of DSM in 2040 will be 6.8 million if low case is assumed. The population in 2040 will be 6.8 million if average case is assumed.



Source: JST projected based on World Urbanization Prospects (The 2014 Revision) by United Nations and Past National Housing and Population Census by NBS

Figure 6.2.7 Population Projection of DSM by Trend of World Mega Cities Method

(5) Capacity of Available Land

Appropriate population estimated from the viewpoint of suitable land area and possible population density were estimated based on planning standard. Out of 1,393 km^2, about 1,272 km^2 are suitable areas for development. The details are shown in Sub-Chapter 10.1. Suitable area consists of the areas excluding unsuitable development areas such as flood-prone areas, steep slope areas, and protected areas. Capable population for each level is calculated by multiplying suitable area for development by possible population density. Possible population density was set based on the trend of population growth. Estimated capable population of DSM will be about 12 million persons.

Table 6.2.6 Estimation of Capable Population

Population Density in 2012	Suitable Area for development	Possible Population Density	Capable Population
Less than 3,299 persons/km^2	1,054.7 km^2	8,000 persons/km^2	8,437,316
3,300 to 7,999 persons/km^2	91.3 km^2	10,000 persons/km^2	1,036,391
8,000 to 15,999 persons/km^2	72.5 km^2	16,000 persons/km^2	1,160,498
16,000 to 19,999 persons/km^2	10.7 km^2	20,000 persons/km^2	213,372
More than 20,000 persons/km^2	42.6 km^2	The same pop. Density as 2012	1,188,777
Total	1,271.8 km^2	Total	12,036,354

(6) Impact of Shifting Government Functions to Dodoma

According to Prime Minister's Office, as of September 2017, a total number of 2,500 workers have shifted from DSM to Dodoma while 2,641 workers will shift by the end of 2017. Number of workers who are still in DSM is 11,500. JST estimated that the total number of the national government officials is 14,000 and 56,000 persons in total would move to Dodoma, by assuming that one official has three other family members, or one household size is four persons. NBS estimated that DSM population as of 2017 is about 5,700,000, so only about one percent of DSM population will move to Dodoma and the impact of the shift to future DSM population is small.

6.2.2 Summary of Frameworks

The future population for 2040 is estimated to be 12 million in DSM and 15 million in greater DSM, ranging up to 50km away from the CBD based on the analysis of the past population trend, and its share of Tanzania and other mega cities in the world. Annual average growth rate of GDP of Tanzania until 2040 is assumed at 6% and car ownership in DSM is assumed to increase from 33 per 1,000 people in 2017 to 75 per 1,000 people in 2040.

Table 6.2.7 Future Framework for Transport Demand Forecast

Item \ Year	a. 2017	b. 2040	Growth Rate Times(b/a) % : annual growth rate
Population	●**5.8million in DSM** ●**6.2million in Greater DSM** estimated by the trend between 2002 and 2012	●**12 million in DSM** ●**15 million in Greater DSM** Including 3million in neighboring wards outside DSM within 50km away from CBD	●**2.07 times, 3.2%** ●**2.59 times, 4.2%**
GDP Growth Rate in TZ	● **7 %** Between 2013 and 2016 In statistics	● **6 %** Between 2017 and 2040	●**3.82 times, 6.0%**
GDP per capita in DSM	●**3.4 million Tsh** estimated by the past statistics date	●**6.3million Tsh**	●**1.85 times, 2.7%**
Car ownership per 1,000 persons	●**33 vehicles per 1,000 persons** Based on the home interview survey in 2017	●**75 vehicles per 1,000 persons**	●**2.27 times,3.6%**

Source: JST

6.3 Vision, Policy and Strategy

Vision, policy and strategy of the Urban Transport Master Plan are set up after discussions in TWGs, Secretariat and JCC.

6.3.1 Vision

"Transit Oriented Mega City" is established as the concept of Urban Transport Master Plan. The concept implies the following visions:

Sustainable Development

JICA Study Team initiates development concept of DSM Urban Transport as "Transit Oriented Mega City". It means DSM will become one of the Mega Cities with a population of more than 10 million in 2040 by promoting TOD approach. CBD shall be connected with Sub-centres and Satellite cities through five radial roads and one circular urban corridor. With these networks and urban structure, CBD function shall be decentralized, and DSM will transform from mono-centric to poly-centric city. Substantial size of compact cities shall be developed along urban corridors, as people commute mainly by public transport provided on the corridors. Those urban structures shall be sustainable and urban corridors shall be developed by TOD approach.

Equal Opportunities in the Society

DSM aims to be a sustainable Mega City in the future, through the development of reliable public transport network, well-built road infrastructure, and smart traffic management system. With those developments, the DSM citizens acquire the alternative options for the public transport mode or route, with safety, convenience, smooth, and reasonable fare. It contributes to providing equal opportunity for the society to get employment or education.

Efficiency in Economic Activities

As the international port city facing the Indian Ocean, DSM shall be developed by the inter-city railways and expressway network, which support long distance trips and logistics. Punctuality and mobility speed shall be improved; traffic congestion and economic loss shall be effectively decreased by these developments. It improves the efficiency of economic activities, and thus, lead the national economy.

Environmental Friendly

Implementation of M/P shall lead DSM to be an environmental friendly city. Future urban structure shall promote the appropriate land use, balanced between development and environmental conservation, avoiding the destruction of nature; improve effective utilization of land use, and high mobility with environmental friendliness.

6.3.2 Policy

Based on the visions, six policies are set up to respond to the key issues described in Figure 6.3.1.

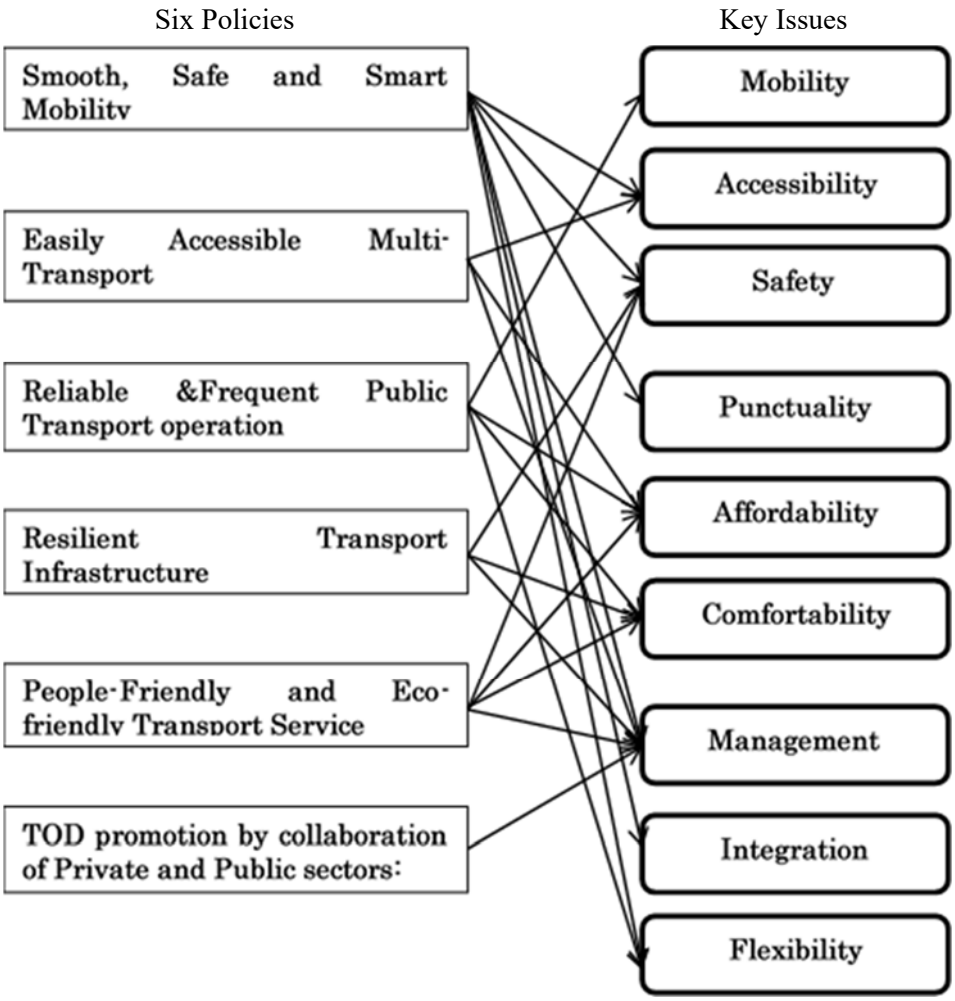
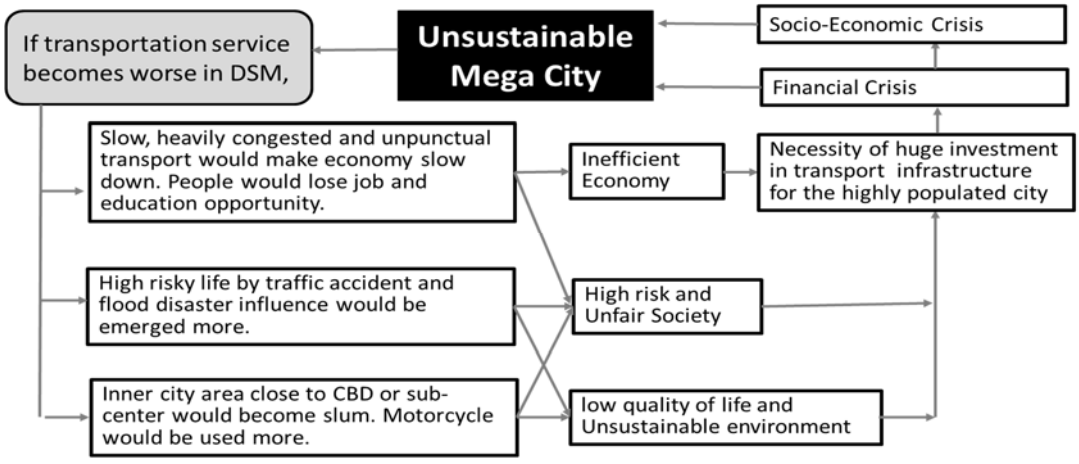


Figure 6.3.1 Relation between Six Policies and Nine Key Issues

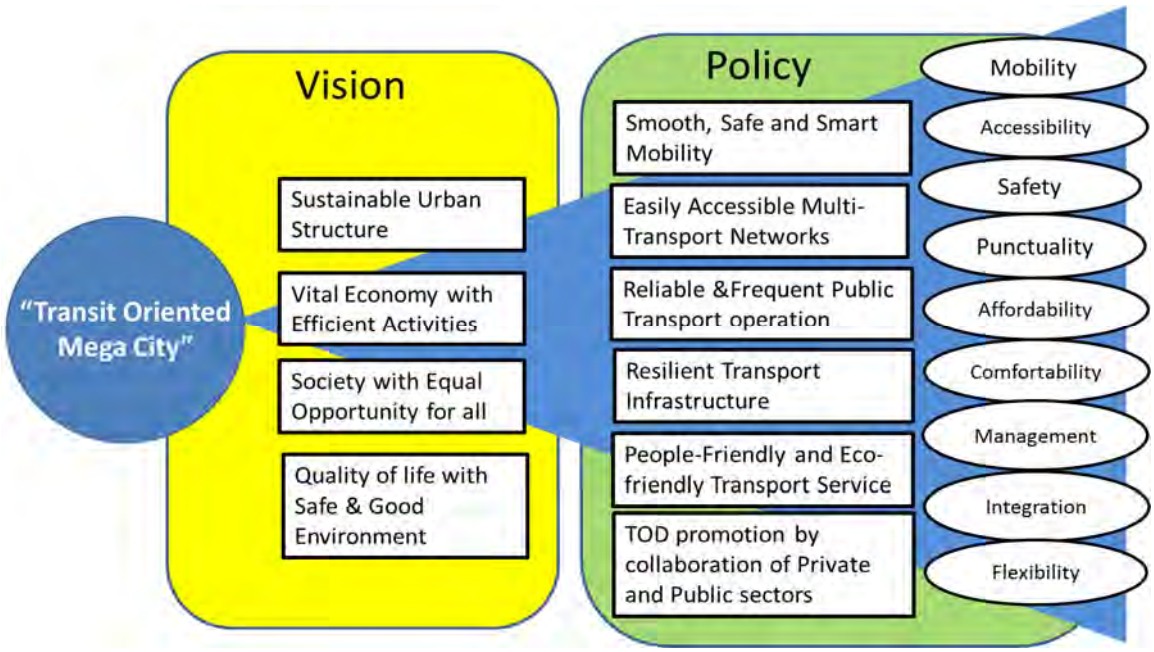
If the investment opportunity for sustainable transport system is missed or conducted unsuitably, transportation service level would drop continuously and finally get into the vicious circle of city decline as shown in Figure 6.3.2.



Source: JST

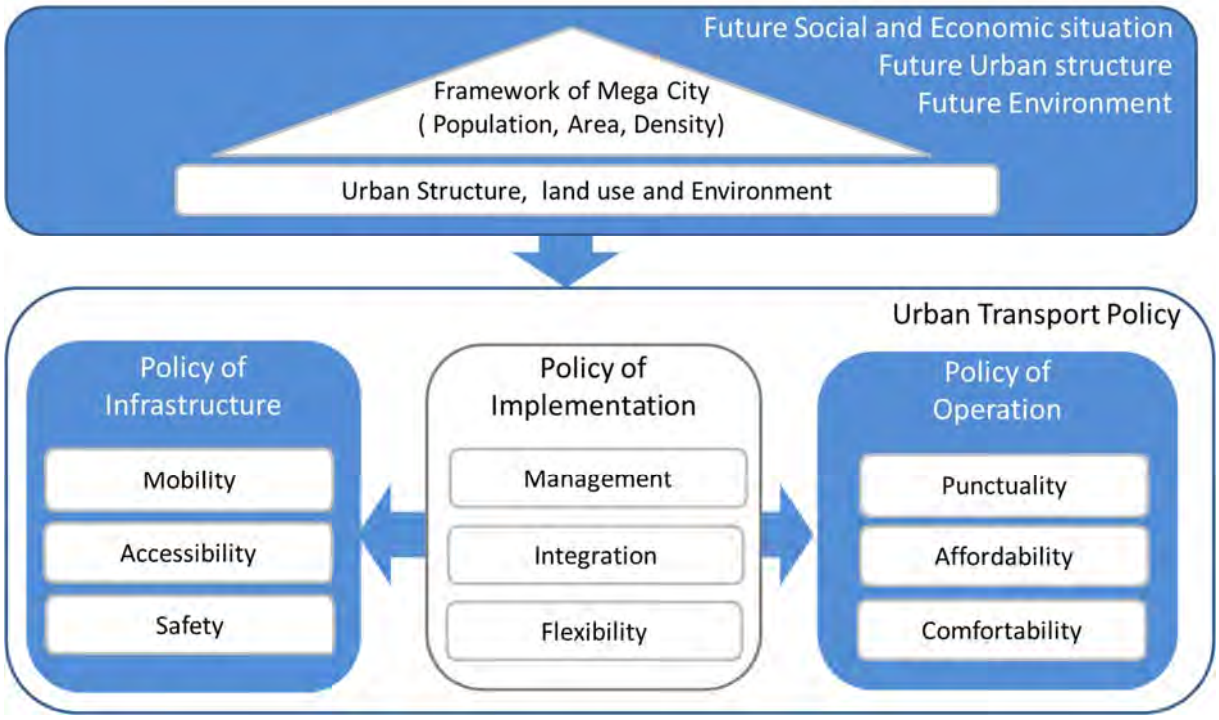
Figure 6.3.2 Vicious Circle of Mega City If Transport Service Becomes Worse in the Future

Concept, Vision, Policy and Key words of issued are summarised in Figure 6.3.3 and 6.3.4.



Source: JST

Figure 6.3.3 Vision and Policy



Source: JST

Figure 6.3.4 Basic Policy Classification Relating to Key Issues

6.3.3 Strategy

Under the strategic targets established, the following twelve strategies are suggested as shown in Table 6.3.1.

1) Introducing high speed public transport network such as MRT and BRT

In order to be able to commute within one hour in DSM and move within 30 minutes in the central area, an operation speed of more than 30 km/h is expected for railway.

2) Introducing expressway for long distance trips

In order to enable to carry cargoes smoothly and move between cities with long trip length, an expressway connecting to DSM port is expected to be constructed.

3) Enhancing feeder road network with higher density

In order to enable access to BRT and railway, feeder bus services should be enhanced in suburbs by improving road density which is suggested in the road plan of this M/P.

4) Improvement of intersection to safer and more resilient structure

In order to be able to move safe and smoothly flood-prone intersections should be improved to become safer and more resilient.

5) Introducing Traffic Control System

In order to manage traffic flows in smarter way, traffic control or management system should be installed as soon as possible.

6) Punctual and frequent operation of Public Transport

In order to promote public transport use, railway should be operated more frequently and punctually.

7) Introducing elevated and tunnel structure of public transport

In order to avoid influence of flood and road congestion, public transport like railway should have excluding lanes, elevated structures and tunnels.

8) Establishing the staging plan based on the agreement among stakeholders

In order to implement M/P projects, step by step staging plans of all related sectors have a key role under the agreement among stakeholders.

9) Establishing the Simple Coherent MP Management Mechanism

In order to be able to carry cargoes smoothly and move between cities with long trip length, an expressway connecting to DSM port is expected to be constructed.

10) Enhancing urban Land Use system

In order to build palm and fingers urban structure in the future, a new M/P including a land use plan is necessary.

11) Capacity development of TOD promotion

In order to implement TOD, capacity development of related organizations is necessary

12) Introducing flexible transport system

In order to deal with rapid increasing traffic demand with fluctuating patterns, flexible supply operation of public transport and roads are expected.

Table 6.3.1 Strategy of Urban Transport Master Plan

Policy		Strategic Target and Indicators of outcome	Strategy
Policy of Infrastructure	Mobility	1. 1 hour in the city by public transport 2. 30 minutes in the central area by public transport 3. Congestion ratio with less than 1.25 on trunk roads 4. Average speed of cars per day are greater than 30km/h in DSM	**1) Introducing high speed public transport network such as MRT and BRT** **2) Introducing expressway for long distance trips** **3) Enhancing feeder road network with higher density** **4) Improving intersections to have a safer and more resilient structure** **5) Introducing Traffic Control System** **6) Punctual and frequent operation of Public Transport** **7) Introducing elevated and tunnel structure of public transport** **8) Establishing the staging plan based on the agreement among stakeholders** **9) Establishing the Simple Coherent MP Management Mechanism** **10) Enhancing urban Land Use system** **11) Capacity development of TOD promotion** **12) Introducing flexible transport system**
	Accessibility	5. Within 1 km access to Public Transport route in suburb of DSM	
	Safety	6. Reducing Traffic accident especially at intersections on the trunk road 7. Reducing Flood disaster especially at intersections on the trunk road	
Policy of Operation	Punctuality	8. Reducing Delay Time within 15 minutes for Railway operation	
	Affordability	9. Affordable fare of public transport for low income workers and students at cheaper than gasoline cost per km	
	Comfortability	10. Crowded Ratio of Public Transport Vehicle less than 150%	
Policy of Implementation	Management	11. Steady Implementation along the staging plan	
	Integration	12. Integration of Land use plan, Road, Public Transport and Traffic management	
	Flexibility	13. Flexible supply responding to demand change and fluctuation	

Source: JST

CHAPTER 7 URBAN STRUCTURE PLAN ALTERNATIVES

7.1 Vision and Target to be Considered in Urban Structure

A vision is a distant view of the plan and goals, and includes what to do to achieve these in the future. All proposed plans in the revision of the current UTMP should be consistent with the vision. The current M/P has its vision of "The Gamma World City", in which DSM aims to be a city like Amsterdam, Geneva, and Johannesburg. After that, Ministry of Land, Housing and Human Settlements Development (MOLHHSD) drafted Dar es Salaam Urban Master Plan (DUMP 2012-2032). Draft DMUP 2012-2032 has not been approved and MOLHHSD has made an effort to finalize the formulation. MOLHHSD supports the vision of draft DUMP 2012-2032, so UTMP to be revised follows the vision developed in the draft DUMP 2012-2032 to ensure the consistency with DUMP 2012-2032.

Table 7.1.1 Vision and Mission in Draft Dar es Salaam Urban Master Plan 2012-2032

	Description
Vision	This master plan is intended to guide sustainable development of the City of Dar es Salaam into being **a desired, liveable, economic regional gate way in Eastern and Central Africa**.
Mission	To have a master plan that caters for socio-economic growth and development needs of a mega city by grounding its value and urban wealth in the hands of its people.

Source: Draft Dar es Salaam City Master Plan: 2012 - 2032

As mentioned in Chapter 6, "Transit Oriented Mega City" is suggested as the concept of Urban Transport Master Plan. Table 7.1.2 shows the summary of Vision and Policy of Urban Transport Master Plan.

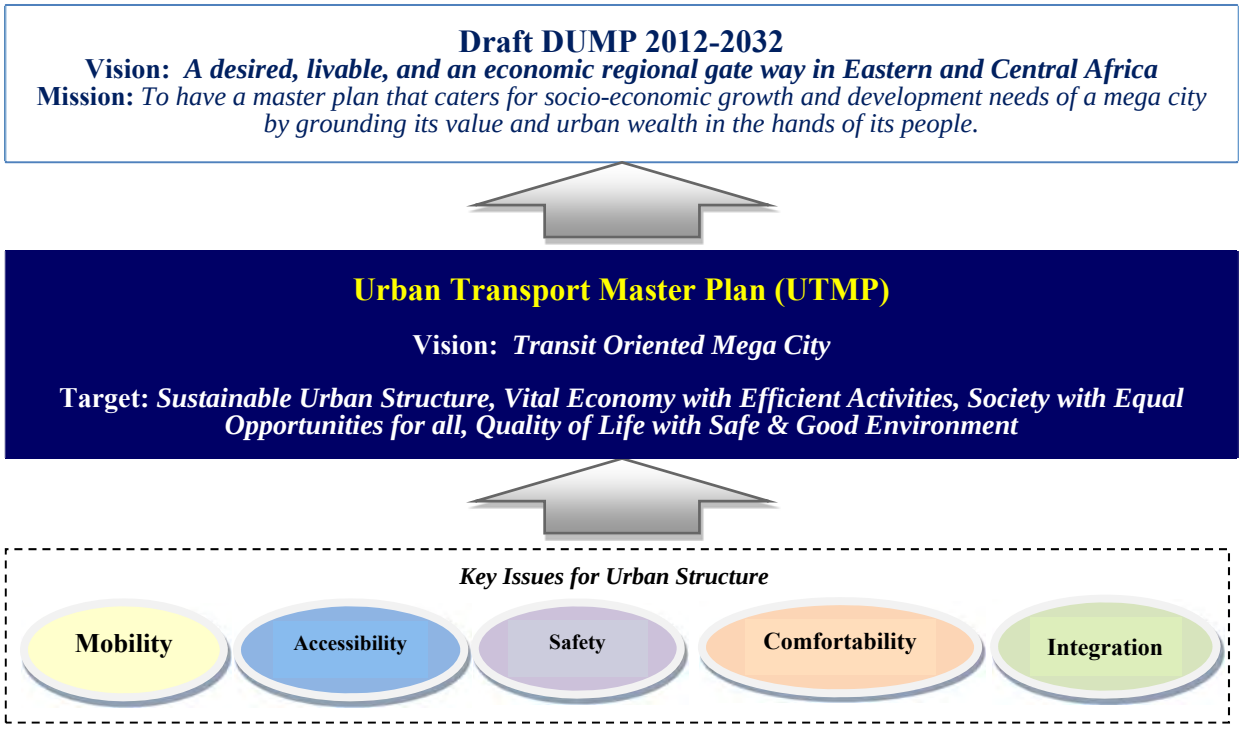
Table 7.1.2 Vision and Policy of Urban Transport Master Plan

	Description
Vision	Transit Oriented Mega City
Target	- Sustainable urban structure - Vital Economy with Efficient Activities - Society with Equal Opportunity for all - Quality of life with Safe and Good Environment
Policy	- Smooth, Safe and Smart Mobility - Easily Accessible Multi-Transport Networks - Reliable & Frequent Public Transport Operation - Resilient Transport Infrastructure - People-friendly and Eco-friendly Transport Service - TOD Promotion by collaboration of Private and Public Sectors
Key Issues	Mobility, Accessibility, Safety, Punctuality, Affordability, Comfortability, Management, Integration, Flexibility

Source: JST

By comparing the two visions above, the common key words can be extracted. The "liveable" in DUMP vision means nice or good enough to live in, and it is correlated with mobility, accessibility, safety, punctuality, affordability, and comfortability. From the viewpoint of urban structure, the "liveable" is consistent with mobility, accessibility, safety, and comfortability. The "socio-economic growth" in DUMP mission is correlated with target of "Vital Economy with Efficient Activities" of Urban Transport Master Plan. The vision, target, policy, and key issues of Urban Transport Master Plan has common directions with the vision and mission of DUMP 2012-2032.

The following key issues, which are consistent with the key issues of Urban Transport Master Plan, are to be addressed when programs and projects are formulated. These key issues are considered in setting urban structure which will contribute to the vision set in draft DUMP 2012-2032 as well as the vision for Urban Transport Master Plan.



Source: JST and Draft Dar es Salaam City Master Plan: 2012 - 2032

Figure 7.1.1 Visions and Key Issues

7.2 Basic Policy for Urban Structure

7.2.1 Land Use Trend

As seen in Chapter 4, major urban functions and activities concentrate in the city centre and the urbanised area expands along the major arterial roads and rail roads. Urbanized area expands to north-west, west, and south-west due to geographical constraints.

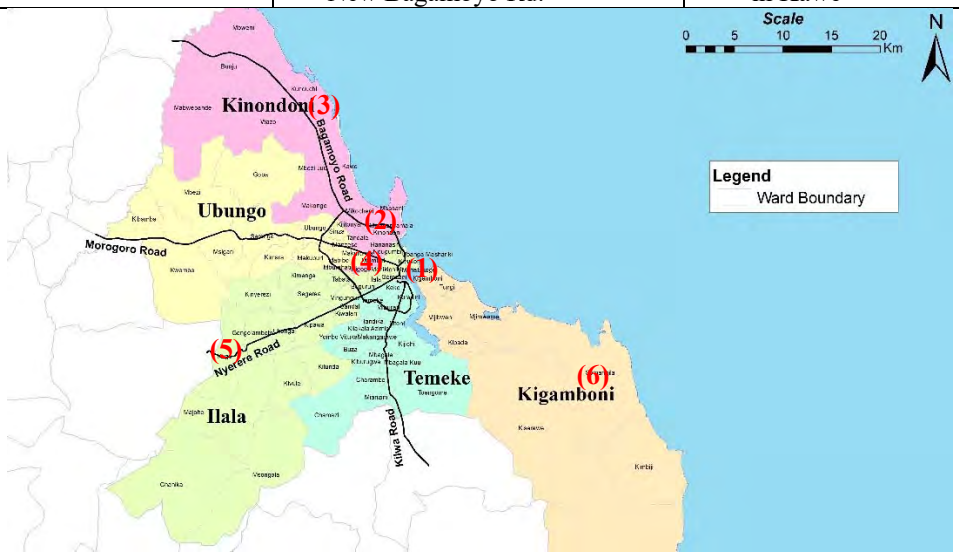
High density areas are distributed inside CBD and along the Nelson Mandela Rd., located between 5km and 10km away from the CBD. Low density residential areas expand outward at urban fringe near city boarder.

Corridor developments for commercial and business are on-going along New Bagamoyo Rd. Some housing development of apartment houses can be seen in Kawe and Kigamboni. Mwalimu Nyerere Bridge (Kigamboni Bridge) was constructed and opened, but land use in Kigamboni was not changed largely. No residential developments are progressing at flood-prone areas of the Msimbazi River near Magomeni, so risk of exposure to floods is small.

(1) High dense area in CBD

(2) Development along New Bagamoyo Rd.

(3) New Residential Development in Kawe



(4) Flood prone area near Magomeni

(5) Low dense residential area near city boarder

(6) New Residential Development in Kigamboni

Source: JST

Figure 7.2.1 Recent Land Use in DSM

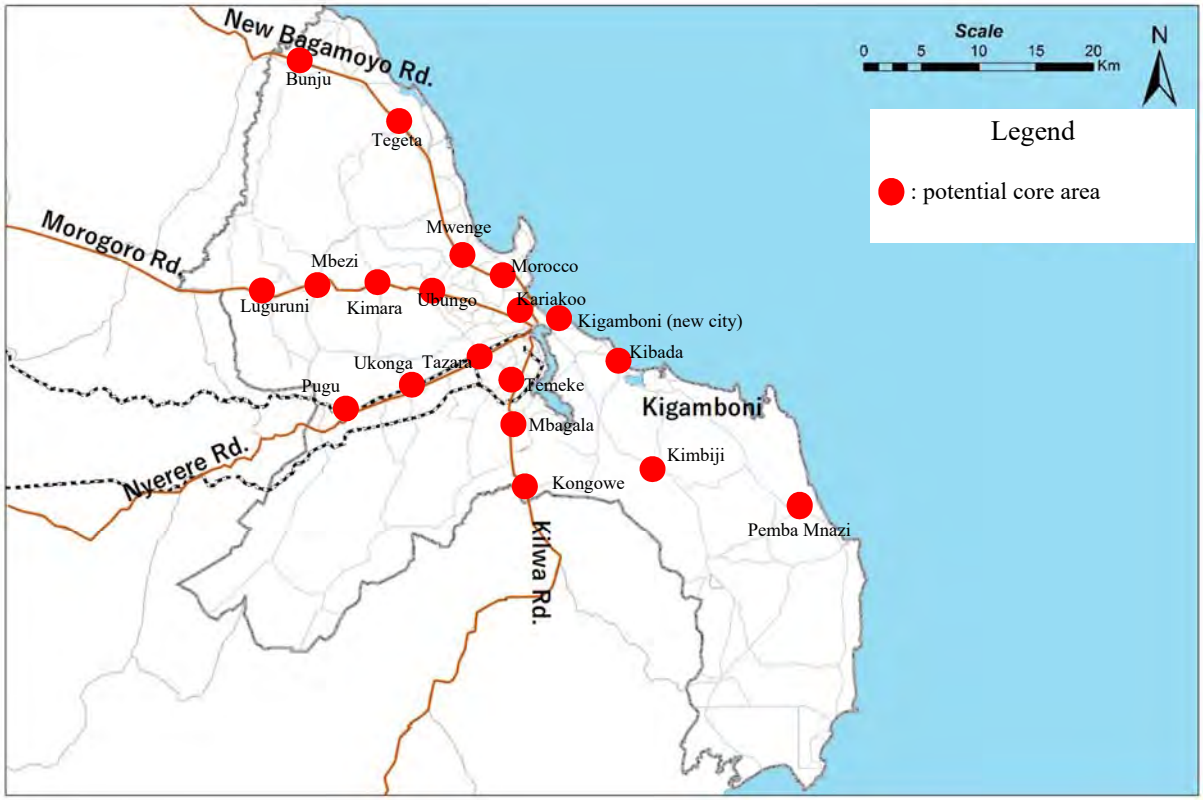
7.2.2 Potential Urban Cores

Small scale agglomeration can be seen at the existing transport hub such as train station and BRT bus terminals such as Ubungo, Kimara. Satellite cities proposed in the draft DUMP 2012-2032 such as Bunju and Luguruni have potential of urban agglomeration in future. The following areas are the potential core areas in future. Here, core areas are defined as the areas which have agglomeration of urban functions and form satellite cities or sub-centres. Definition of satellite cities and sub-centres in this study is mentioned in the sub-section of 7.2.3.

- New Bagamoyo Rd.: Morocco, Mwenge, Tegeta, and Bunju
- Morogoro Rd.: Ubungo, Kimara, Mbezi, and Luguruni

- Nyerere Rd.: Kariakoo, Tazara, Ukonga, and Pugu
- Kilwa Rd.: Temeke, Mbagala, and Kongowe
- Kigamboni: Kigamboni (new city), Kibada, Kimbiji, and Pemba Mnazi

Figure 7.2.2 shows the distribution of potential core areas. Formation of these areas will be possible with the development of transport hubs such as BRT Terminals, as cores with urban development such as commercial and business development have been developed at Morocco and Kariakoo where the BRT Terminals as transport hubs were already developed. It is because utilising the existing infrastructure is more efficient than developing brand new infrastructure to upgrade the core areas for sub-centres or satellite cities. These are the candidate cores for sub-centres or satellite cities to be considered for urban structure alternatives in sub-section of 7.3.



Source: JST

Figure 7.2.2 Distribution of Possible Urbanization Area

7.2.3 Basic Policy for Urban Structure

Urban Structure is a conceptual development pattern which indicates distribution pattern of urban functions and road networks. Possible distribution of the following components is considered to prepare urban structure alternatives.

Components of Urban Structure

- **CBD :** Representative Business and Commercial Centre
- **Sub-Centre:** Second-level Business and Commercial Centre
- **Satellite City:** Business, Commerce, Administrative, and Residence

- **Road Network:** Major Arterial Road and Ring Road

As mentioned in Chapter 4 and 7.2, the problems of the current urban structure and land use are 1) urban sprawl which tends to expand outward and change open spaces to residential area and 2) concentration of urban functions such as business, commerce, administration, etc. only to CBD. The current urban structure is called mono-centric urban structure, which causes environmental deterioration and economic loss by increasing traffic jam.

Population of DSM will be more than 10 million in 2040. The current structure will worsen the urban problems and make it difficult to form the city stated in the vision. To propose urban structure alternatives to shape the city stated in the vision, dispersing some urban functions from CBD and development of ring road is considered. In the alternatives, zero option (Do Nothing Case) is also considered.

(1) Dispersing some urban functions from CBD

To mitigate excessive concentration of urban functions to CBD and solve urban problems, dispersing some urban functions from CBD is considered for proposing urban structure alternatives. Currently, CBD has wide variety of urban functions such as administration, business and commerce, accommodation, and health. Some urban functions of CBD will be newly introduced to other areas. It does not mean some functions of CBD will be relocated from CBD. It means some functions will co-exist at CBD and other areas. The advantageous areas to accommodate the dispersed urban functions are the current transport hubs such as BRT terminals and bus terminals and planned development sites by MOLHHSD and National Housing Cooperation. (NHC). These areas are potential urban cores mentioned in 7.2.2.

(2) Development of ring road

Road network is an important component of urban structure and plays an important role to sustain urban activities. Major arterial roads such as New Bagamoyo Rd., Morogoro Rd., Nyerere Rd., Kilwa Rd., Nelson Mandela Rd. have been developed, but development of more roads especially ring roads is important to sustain activities and increasing population. Development of ring roads is indispensable to mitigate through-traffic into CBD, to disperse traffic from suburb to CBD, to enable direct access between an urban core in suburb and another urban core in suburb without passing through CBD, and to enable detour in case of disasters and accidents. Development of ring roads will contribute to congestion mitigation, logistical efficiency, and rapid rescue in emergencies as mentioned in sub-chapter 10.2.

7.3 Formulation of Urban Structure Alternative

7.3.1 Urban Structure Alternatives

As a prototype of the urban structure, two types of urban structures can be considered. One is the mono-centric urban structure, in which main urban functions will concentrate solely in CBD. The other type is dispersed urban structure, in which some urban functions will be dispersed from the existing CBD to other core areas such as sub-centres or satellite cities. Dispersed structure is largely divided into three sub-types depending on allocating patters of satellite cities and sub-centres.

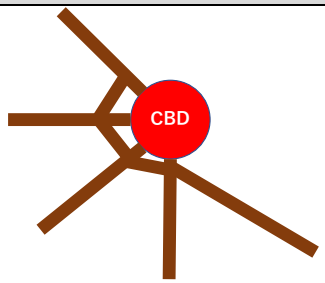
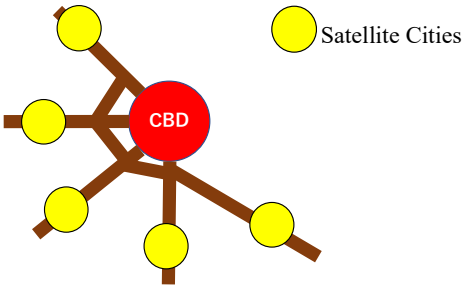
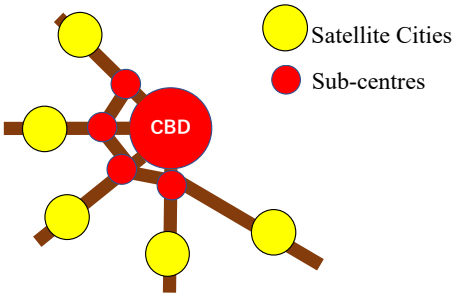
Table 7.3.1 shows the images of prototypes of each urban structure type and sub-type. Mono-centric urban structure is a prototype for the alternative of “Case 0”. Dispersed urban structure has three sub-types. The first sub-type is the structure with satellite cities to have some urban functions dispersed from CBD, which is a prototype for the alternative of “Case 1”. The second sub-type is the structure with both satellite cities and sub-centres to have some urban functions dispersed from CBD, which is

a prototype for the alternative of "Case 2". The third sub-type is the structure with sub-centres to have some urban functions. In this study, an alternative for this sub-type with only sub-centres is not considered because Long-Term Perspective Plan in Tanzania specifies to build satellite cities to disperse the urban functions from CBD.

Moreover, the alternatives of dispersed urban structures have been elaborated based on the above basic policy for urban structure: i) dispersing some urban functions from CBD, ii) development of road networks.

As such, JST set three cases for urban structure: i) Case 0: Do Nothing or Trend Type, ii) Case 1: Satellite Cities Development, and iii) Case 2: Balanced Structure with Satellite Cities and Sub-centres. During the study period, one of the alternatives will be adopted. Land use policy and land use plan as well as urban transport plan will be formulated based on the alternative to be adopted.

Table 7.3.1 Prototype of Urban Structure

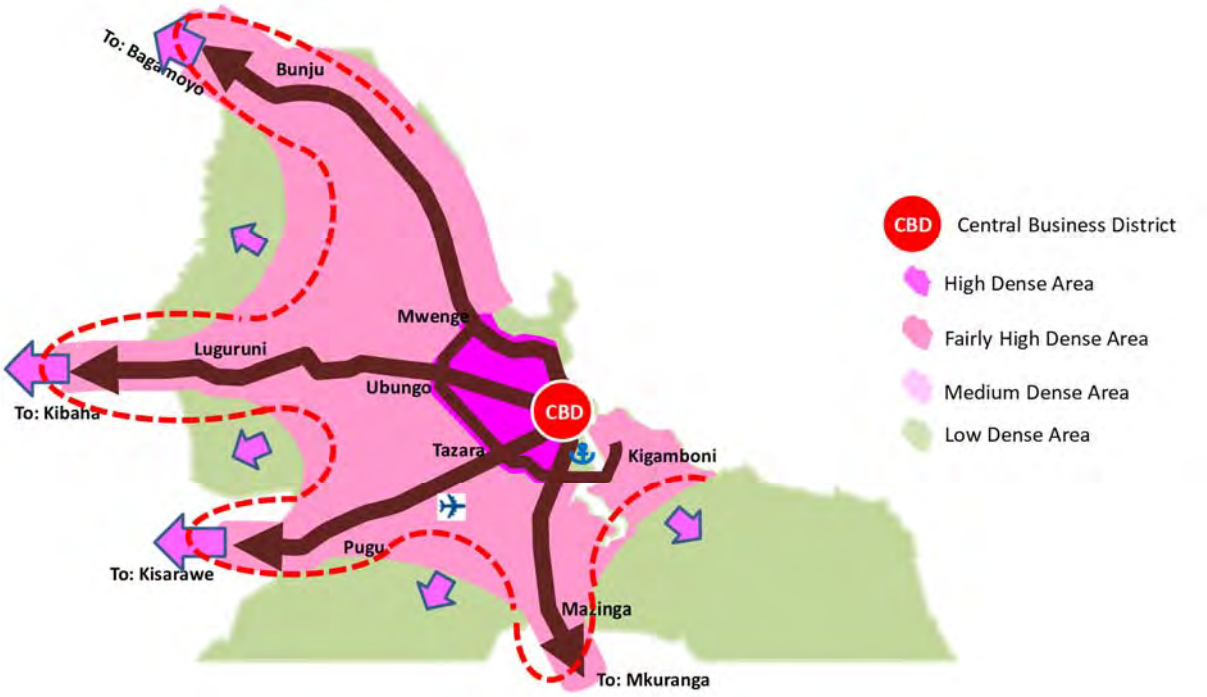
Type	Component		Image of Urban Structure	Alternatives in the Study
Mono-centric Urban Structure	CBD			Case 0
Dispersed Urban Structure	(a)	- CBD - Satellite Cities		Case 1
	(b)	- CBD - Sub-centres - Satellite Cities		Case 2

Source: JST

(1) Case 0: Do Nothing or Trend Type

Mono-centric structure is option zero and a prototype of the alternative of "Case 0". This alternative is prepared for the comparison among the alternatives.

As such, JST set three cases for urban structure: i) Case 0: Do Nothing or Trend Type, ii) Case 1: Satellite Cities Development, and iii) Case 2: Balanced Structure with Satellite Cities and Sub-centres. During the study period, one of the alternatives will be adopted. Land use policy and land use plan as well as urban transport plan will be formulated based on the alternative to be adopted.



Source: JST

Figure 7.3.1 Urban Structure Alternative (Case 0: Do Nothing or Trend Type)

(2) Case 1: Satellite Cities Development

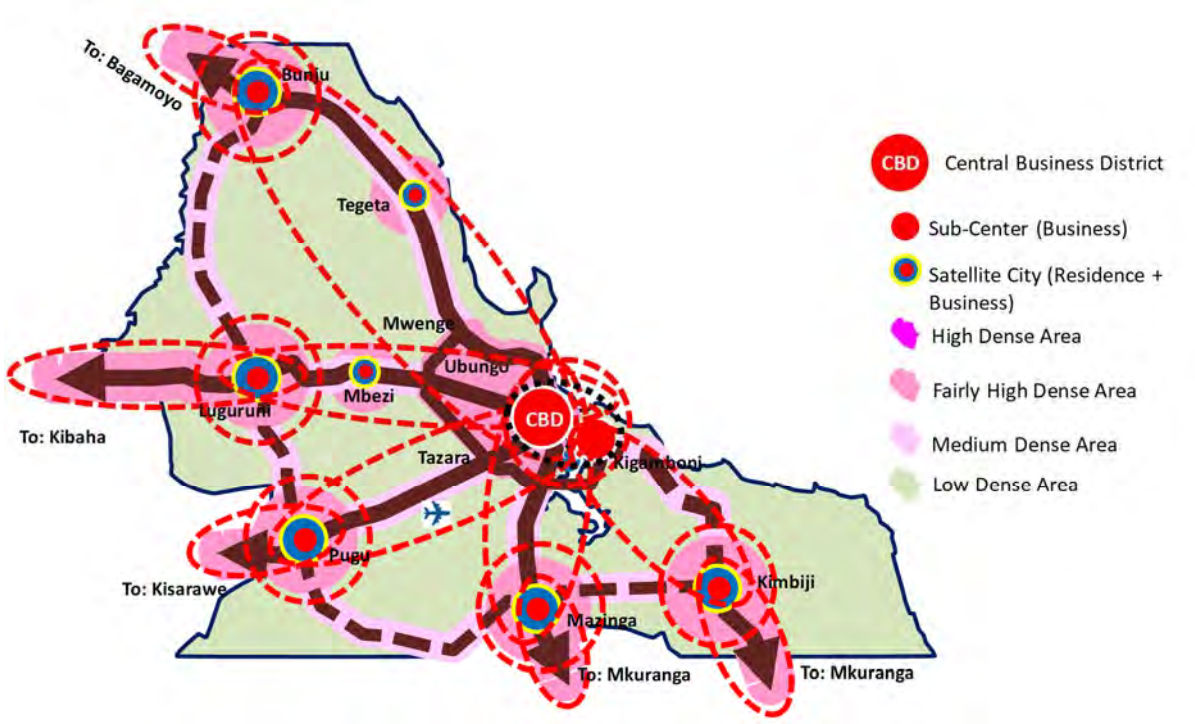
Image of "Satellite Cities Development" urban structure is shown in Figure Satellite cities having residential and business functions will be developed in Bunju, Luguruni, Pugu, Kongowe, and Kibada. Tegeta and Kimara will be developed as smaller satellite cities. Concentration to CBD will be mitigated by dispersing urban functions to satellite cities. Urban sprawl beyond 10km from CBD will be also mitigated. Red dotted line in the figure shows the image of generation and concentration of the trips. Trips will be made within CBD, satellite cities as well as between satellite cities and CBD. Development of new Kigamboni City is also considered in this structure.

The assumed average sizes of satellite cities are shown as in Table 7.3.2.

Table 7.3.2 Assumed Size of Inner Satellite City and Outer Satellite City (Case 1)

	Land Area (ha)	Population (persons)	Working population at working place (persons)
Inner Satellite City (Tegeta, Mbezi)	500 ha	52,500	30,000
Outer Satellite City (Bunju, Luguruni, Pugu, Kongowe, Kibada)	1,000 ha	145,000	350,000

Source : JST



Source: JST

Figure 7.3.2 Urban Structure Alternative (Case 1: Satellite Cities Development)

(3) Case 2: Development with Satellite Cities and Sub-centres

Figure 7.3.3 shows image of "Development with Satellite Cities and Sub-centres". This case has sub-centres having business functions and a ring road connecting Tegeta, Kimara, and Ukonga, in addition to satellite cities. Some business functions of CBD will be dispersed to sub-centres. A ring road connecting inner satellite cities such as Tegeta and Kimara will support traffic and logistic flow and provide more options for routes to make trips between satellite cities. Trips between satellite cities and CBD will be reduced by developing sub-centres. Although population density is high within 10km radius from CBD, modal shift through Transit Oriented Development will be promoted. Residing in CBD to revitalize CBD will be encouraged. This structure aims at balancing among CBD, satellite cities, and sub centres to mitigate concentration to CBD.

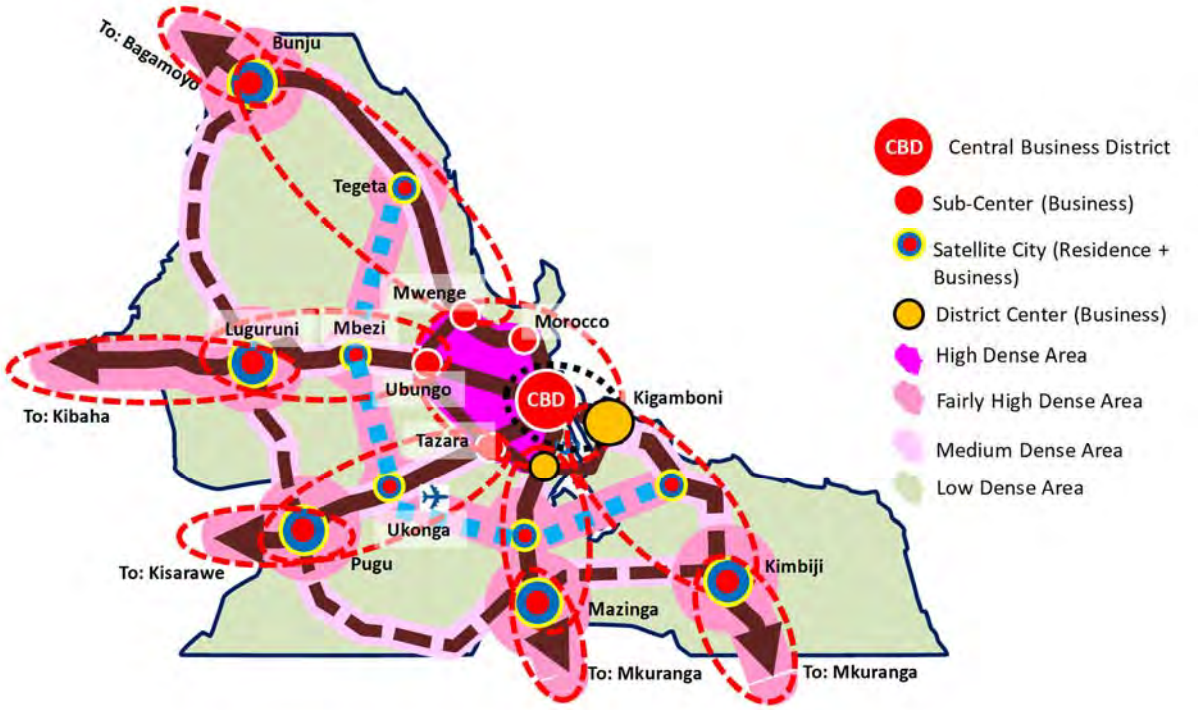
Satellite cities and sub-centres will be developed by both private sectors and public sectors. MOLHHSD will prepare Dar es Salaam Urban Master Plan and Municipal Councils will prepare detail plan for satellite cities and sub-centres based on the Dar es Salaam Urban Master Plan (DUMP). The detail plan will cover both development control measures to follow land use plan specified in DUMP and development promotion measures to accelerate urban development. The promotion measures will be applied to the developments around the transport nodes such as train stations and BRT terminals. Public sectors will work for the developments of basic infrastructure and road/public transport. Private sectors will develop business and commercial buildings. Private sectors developments will be encouraged through the developments of basic infrastructure and road/public transport by public sectors.

The assumed average size of satellite cities and sub-centres are shown as in Table 7.3.3.

Table 7.3.3 Assumed Size of Inner Satellite City and Outer Satellite City (Case 2)

	Land Area (ha)	Population (persons)	Working population at working place (persons)
Sub-Centre	75 ha	25,000	70,000
Inner Satellite City (Tegeta, Mbezi, Ukonga, Mzinga, Kigamboni)	500 ha	80,000	80,000
Outer Satellite City (Bunju, Luguruni, Pugu, Kongowe, Kibada)	1,000 ha	140,000	250,000

Source: JST



Source: JST

Figure 7.3.3 Urban Structure Alternative
(Case 2: Development with Satellite Cities and Sub-centres)

7.3.2 Evaluation of Urban Structure Alternatives

Urban structure alternatives are evaluated by a variety of viewpoints. Firstly, Table 7.3.4 shows Results of TWG-1 Discussion on Merit and Demerit for Each Case, which summarized opinions and views of the TWG members of TWG-1. TWG-1 evaluated that Case 2 is the most suitable for future urban structure for UTMP. This is the result by governmental officials living in DSM.

Table 7.3.4 Results of TWG-1 Discussion on Merit and Demerit for Each Case

	Case 0 Do Nothing or Trend Type	Case 1 Satellite Cities Development	Case 2 Development with Satellite Cities and Sub-centres
Merit	✓ Less investment by government	✓ Reduced congestion in CBD through development of Satellite Cities ✓ Time saving ✓ Increased land values alongside satellite towns ✓ Promotion of business in Satellite Cities ✓ Easy access to social services in Satellite Cities	✓ Reduced congestion in CBD through development of Sub-centres and Satellite Cities ✓ More time saving ✓ Most redundant and resilient by developing rind road ✓ Most competitive in terms of logistic flow ✓ Revitalization of CBD
Demerit	✓ Complicated transport system ✓ Uneven distribution of resources ✓ Traffic congestion increase ✓ Environmental degradation ✓ No land regulation and hence loss of land value ✓ Increased crimes ✓ Loss of competitiveness to other cities in different countries	✓ It involves high cost and consume time to build satellite city	✓ It involves high cost and consume time to build satellite city

Source: JST

Secondly, from the viewpoints of transport planning, preferable urban structure can be evaluated as shown in Table 7.3.5. This evaluation will be verified through traffic demand forecasting later.

Table 7.3.5 Comparative Evaluation from the View of Transport Planning

	Case 0 Do Nothing or Trend Type	Case 1 Satellite Cities Development	Case 2 Development with Satellite Cities and Sub-centres
Total Trip length	Longest Resulted from expanding urban area in disorder manner	Shorter Resulted from building Satellite cities which partly attracts commuting trips instead of CBD	Shortest Resulted from building Satellite cities and Sub-centres which most attract commuting trips instead of CBD
Public Transport Use	Difficult to provide Efficient operation due to scattered urban area with low density and excessive concentration to CBD	Not difficult to provide Efficient operation due to compact urban area along urban corridor with high density but still excessive concentration to CBD	Relatively easy to provide Efficient operation to compact urban area along urban corridor with high density and balanced trip distribution to CBD and Sub-centres
Reduction of Road Congestion	Difficult due to traffic demand increasing with longer trip length	Probably difficult due to traffic concentration on the radial trunk roads with longer trip length	Probably possible due to traffic decentralization with shortest trip length
Evaluation	**Not Preferable**	**Not appropriate** due to huge road investment requirement	**Preferable** due to relatively less road investment

Thirdly, as far as the relationship of vision of M/P with urban structure alternatives is concerned, preferable urban structure can be evaluated as shown in Table 7.3.6.

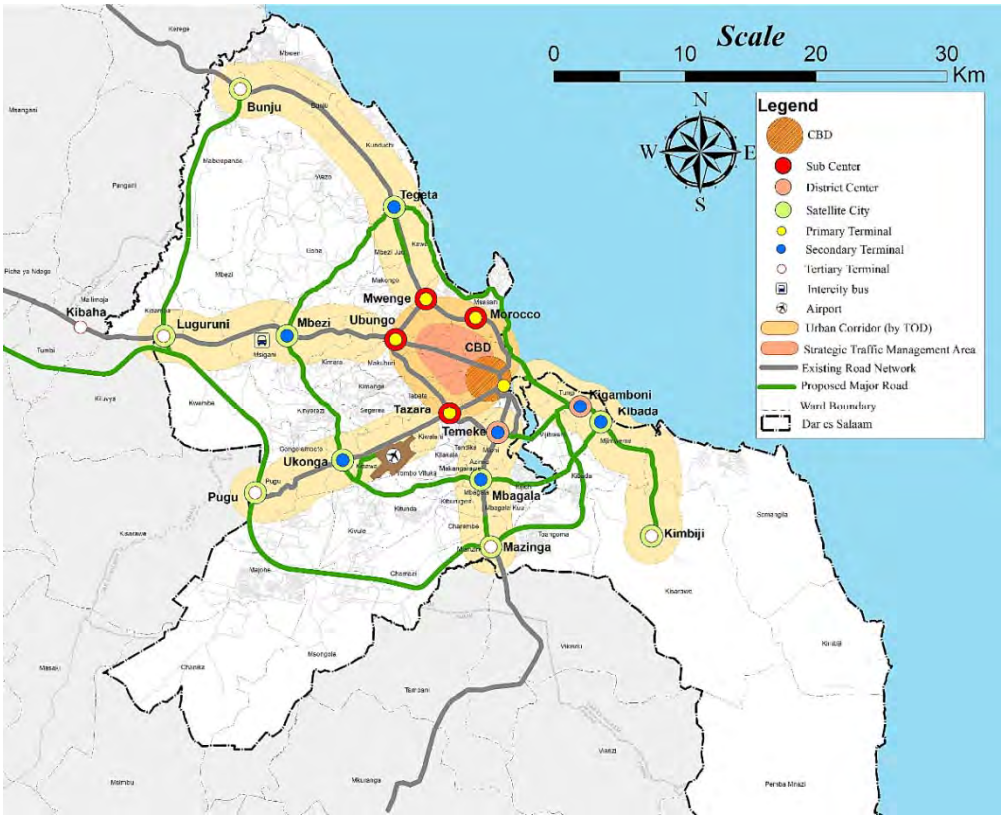
Table 7.3.6 Comparative Evaluation from the Relationship with Vision

Vision	Case 0 Do Nothing or Trend Type	Case 1 Satellite Cities Development	Case 2 Development with Satellite Cities and Sub-centres
Sustainable Development	Unsustainable pattern Resulted from natural environment destruction in suburb and serious road congestion in urban area	Probably unsustainable Resulted from building Satellite cities which contribute to reduce environment destruction than Case-0 but difficult to reduce road congestion	Sustainable pattern Resulted from building Satellite cities and Sub-centres which can avoid environment destruction and reduce traffic congestion
Equal Opportunities in the Society	Difficult to provide public transport service equally and efficiently in the whole area due to scattered urban area with low density	Possible to provide public transportation service efficiently and equally in urban area due to compact urban area along urban corridor with high density, but difficult to provide rapid service from suburb to CBD due to excessive concentration to CBD	Possible to provide public transportation service efficiently and equally in the whole area due to compact urban area along urban corridor with high density and balanced trip distribution to CBD, Sub-centres and Satellite Cities
Efficiency in Economic Activities	Not efficiency Due to becoming worse in traffic congestion and inefficient public transportation service	Efficiency in urban area but not efficiency in suburb Due to becoming worse in traffic congestion and inefficient public transportation service	Possible Due to shorter trip length and efficient public transportation service
Environmental Friendly	Environmental destruction due to urban sprawl in suburb	Environmental problem destruction due to urban sprawl in suburb	Better quality of life
Evaluation	**Not Preferable for Mega city**	**Not suitable for Mega city.** Probably reasonable if the future population is same as the current population	**Preferable in all aspects for Mega city**

As a results of three kinds of the above analysis, the conclusion of the evaluation for three alternatives is that Case (2) was comparatively the more preferable than other cases.

- **Case 0:** This alternative would generate the worst conditions to be avoided in terms of negative development impacts, if "do-nothing" situation happens.
- **Case 1:** This development is the second favourable choice through satellite city development. Surrounding areas of CBD within 10km radius from CBD are not developed much, so it leads to less environmental impact but also less competitiveness than Case 2.
- **Case 2:** This development is preferable to achieve the vision. This alternative is better than two other alternatives. Especially since developing sub-centres with the public transport and road development within 10km from CBD will be able to contribute to making trip shorter, reducing concentration of commuting to CBD and promoting public transport use.

Figure 7.3.4 shows the urban structure map of this master plan, in which the concept of Case 2 is plotted.



Source: JST

Figure 7.3.4 Urban Structure Map

CHAPTER 8 TRANSPORT DEMAND FORECAST

8.1 Future Population Distribution

8.1.1 Population

Future population distribution for each urban structure alternative is an input for future traffic demand forecast. JST sets a population of 15,000,000 as the projected population of DSM in 2040 for each urban structure alternative. JST also assumes that the appropriate population in which DSM can accommodate is 12,000,000 from the viewpoints of possible population density, so 3,000,000 would be distributed to outside.

JST would estimate residential population, working population, and work-place population for each ward. The followings will be assumed for examining future population distribution.

Table 8.1.1 Assumption for Examining Future Population Distribution (Residential Population)

Alternative of Urban Structure	Target Population of DSM	Assumption
Case 0 Do Nothing or Trend Type	12,000,000	• Population of CBD would increase with the trend base. • Population of wards outside CBD would grow. • 3,000,000 people will reside in Kisarawe, Kibaha, and Bagamoyo.
Case 1 Satellite Cities Development		• Population of CBD would increase with the trend base. • Population of wards outside CBD would grow. • Population of wards, where satellite cities are planned, would have higher population density. • 3,000,000 people will reside in Kisarawe, Kibaha, and Bagamoyo.
Case 2 Development with Satellite Cities and Sub-centres		• Population of CBD would increase with higher rate than the trend base, because residing CBD to revitalize CBD is encouraged. • Population of wards outside CBD would grow. • Population of wards, that is located within 10km radius from CBD, would have highest population density, followed by population density of satellite cities. • 3,000,000 people will reside in Kisarawe, Kibaha, and Bagamoyo.

Source: JST

For population of CBD for Case 0 and Case 1, it is assumed that population of CBD would increase with the trend base between 2012 and 2017. Case 0 follows the trend, and Case 1 also follows the trend considering no development control and promotion in CBD as results of concentrating development control and promotion in satellite cities.

Population distribution at each ward was set as follows for each Case:

1) Ninety wards are classified as follows by locational features such as distance from CBD, and whether a ward will have core area such as sub-centres or satellite cities;
2) Set future population density for each zone by considering the current population density in 2017 and possible future growth; and
3) Multiply the future population density for each zone by land area for each ward.

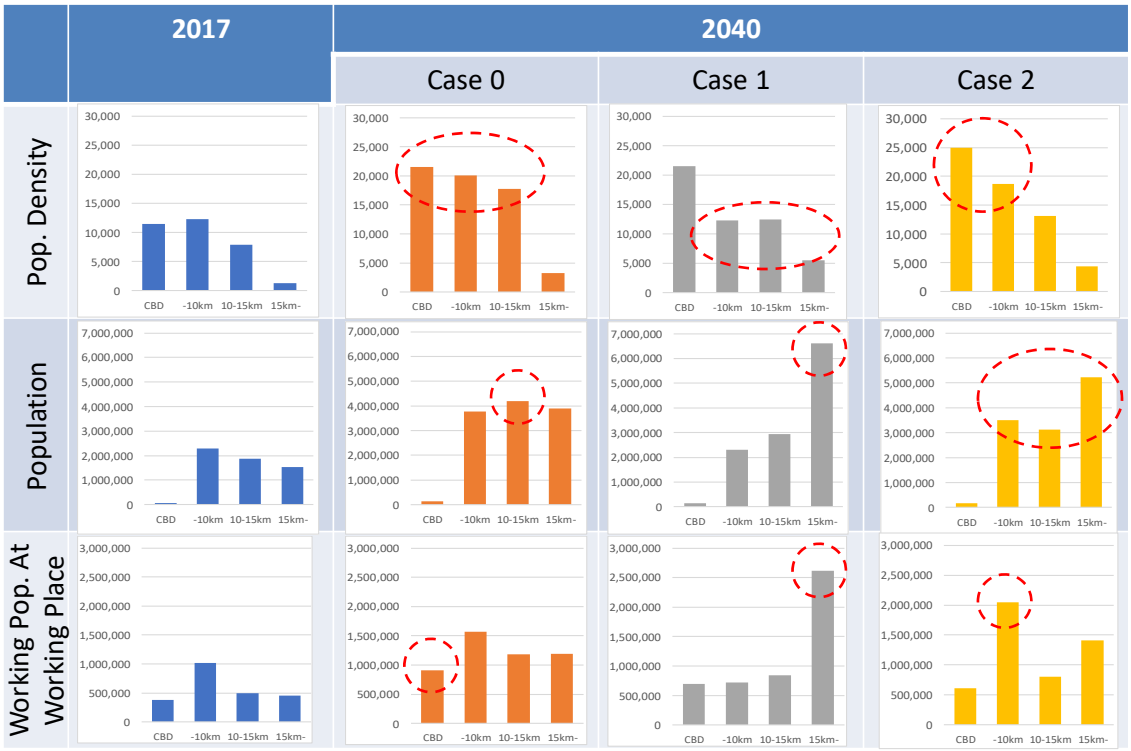
The following table shows the assumed population density for each zone for Case 2.

Table 8.1.2 Classification of Wards and Assumed Population Density for Case 2

Municipal Council	Zone	Classification	Code	Assumed Population Density in 2040 (persons/km^2)
Ilala	CBD	-	CBD	25,000
	Inner	CA: with Core Area	Inner (CA)	55,000
		CR: on Corridor	Inner (CR)	30,000
		NC: Not on Corridor	Inner (NC)	35,000
	Middle	CA: with Core Area	Middle (CA)	12,000
		CR: on Corridor	Middle (CR)	10,000
		NC: Not on Corridor	Middle (NC)	8,000
	Outer	CA: with Core Area	Outer (CA)	12,000
		CR: on Corridor	Outer (CR)	4,100
		NC: Not on Corridor	Outer (NC)	7,000
Kigamboni	Inner	CA: with Core Area	Inner (CA)	685
	Outer	CA: with Core Area	Outer (CA)	485
		NC: Not on Corridor	Outer (NC)	30,000
Kinondoni	Inner	CA: with Core Area	Inner (CA)	30,000
		CR: on Corridor	Inner (CR)	25,000
		NC: Not on Corridor	Inner (NC)	12,000
	Middle	CA: with Core Area	Middle (CA)	12,000
		CR: on Corridor	Middle (CR)	10,000
	Outer	CA: with Core Area	Outer (CA)	12,000
		NC: Not on Corridor	Outer (NC)	2,000
Temeke	Inner	CA: with Core Area	Inner (CA)	25,000
		CR: on Corridor	Inner (CR)	20,000
		NC: Not on Corridor	Inner (NC)	35,000
	Middle	CA: with Core Area	Middle (CA)	34,500
		CR: on Corridor	Middle (CR)	43,600
		NC: Not on Corridor	Middle (NC)	10,000
	Outer	NC: Not on Corridor	Outer (NC)	4,000
Ubungo	Inner	CA: with Core Area	Inner (CA)	12,000
		CR: on Corridor	Inner (CR)	45,000
		NC: Not on Corridor	Inner (NC)	10,000
	Middle	CA: with Core Area	Middle (CA)	12,500
	Outer	CA: with Core Area	Outer (CA)	12,000
		CR: on Corridor	Outer (CR)	7,000
		NC: Not on Corridor	Outer (NC)	4,000

Source: JST

Figure 8.1.1 shows the comparison of distributions in population density, population, and working population at working place in 2017 among Case 0, Case 1, and Case 2. The graph in each case shows the numbers by CBD and locations showing the distance from CBD: 1) CBD, 2) below 10km, 3) between 10km and15km, and 4) over 15km. Case 2 has the most working population at working place below 10km by developing sub-centres.

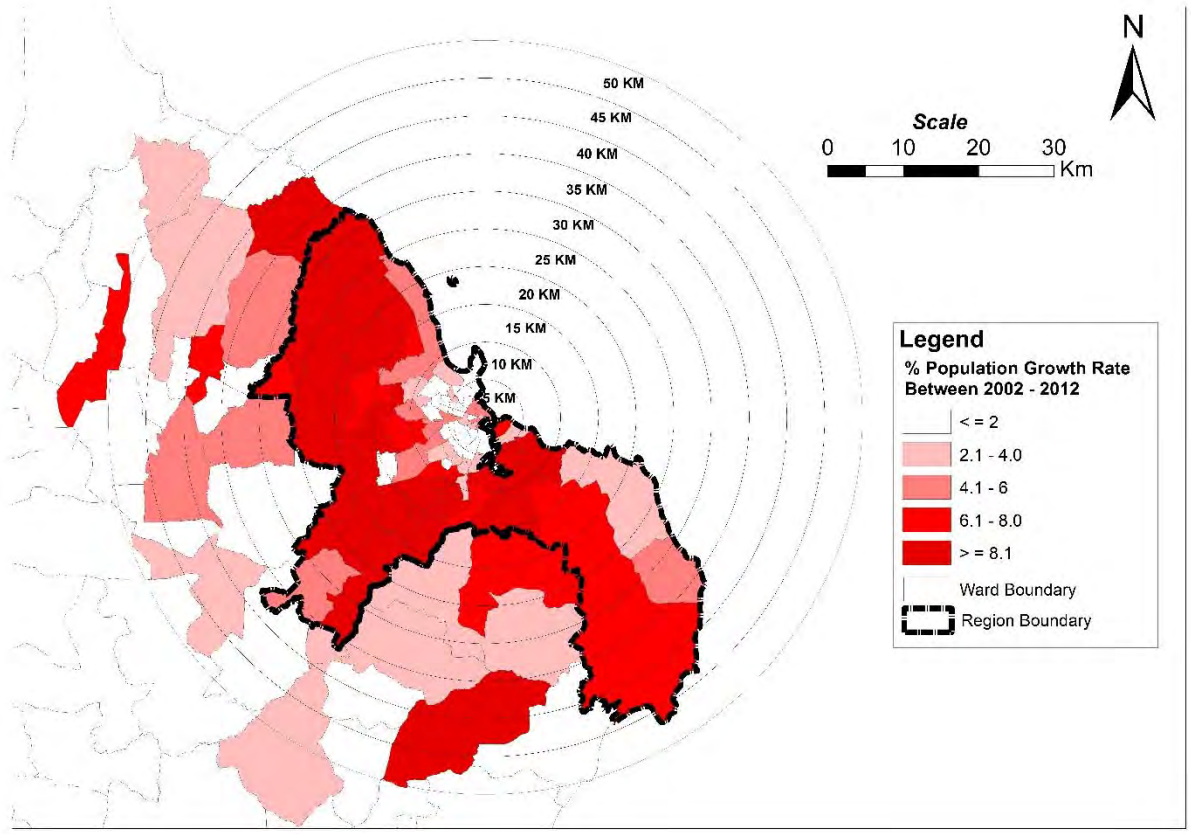


Source: JST

Figure 8.1.1 Comparisons of Distributions of Population Related Indicators by Case

For Greater Dar es Salaam (Greater DSM), three million people out of 15 million are allocated to the wards of Bagamoyo, Kibaha, Kisarawe, and Mkuranga districts within 50km radius from the CBD. Here, Greater DSM is defined as greater area consisting of administrative area of Dar es Salaam Region and surrounding wards of Dar es Salaam which are located within 50km radius from the CBD in Bagamoyo District, Kibaha District, Kisarawe District, Mkuranga District of Pwani Region.

Figure 8.1.2 is a map showing the average annual population growth rate for each of the wards of DSM and within 50km radius from the CBD. Population growth rate at urban fringe of DSM was higher than that of other areas of DSM.



Source: JST based on National Housing and Population Census 2002 and 2012

Figure 8.1.2 Population Growth Rate of DSM and Greater DSM (between 2002 and 2012)

Average annual population growth rate between 2002 and 2012 for wards at urban fringe of DSM is 10.64% and higher than the average rate for DSM (5.60%). The wards at urban fringe of DSM and their annual population growth rate between 2002 and 2012 are shown in Table 8.1.2.

Table 8.1.3 Annual Population Growth Rate between 2002 and 2012 for Wards at Urban Fringe

No.	Municipal Council	Ward	Population 2002	Population 20012	Annual Population Growth Rate between 2002 and 2012
1	Kinondoni	Mbweni	3,866	13,766	13.54%
2		Bunju	23,820	60,236	9.72%
3		Mabwepande	3,357	25,460	22.46%
4	Ubungo	Mbezi	30,197	73,414	9.29%
5		Kibamba	18,001	28,885	4.84%
6		Kwembe	5,654	56,899	25.97%
7	Ilala	Pugu	20,725	49,422	9.08%
8		Majohe	775	81,646	59.32%
9		Chanika	37,095	43,912	1.70%
10		Msongola	6,535	24,461	14.11%
11	Temeke	Chamazi	10,922	63,650	19.27%
12		Mianzini	63,797	100,649	4.66%
13		Toangoma	17,922	44,578	9.54%
		Total/Average	**242,667**	**666,978**	**10.64%**

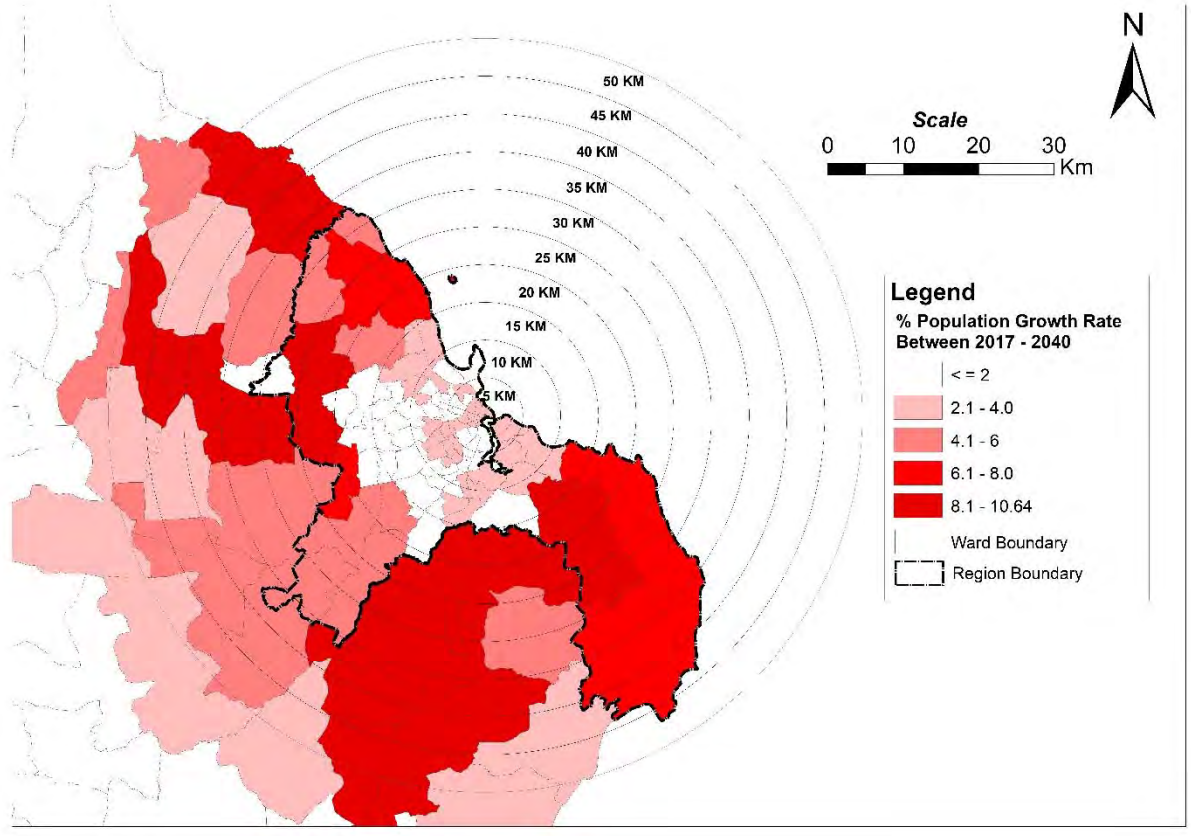
Source: JST based on National Housing and Population Census 2002 and 2012

Considering the factors such as the above recent trend of population growth at urban fringe of DSM and expectation of future land use control to avoid urban sprawl at the wards of urban fringe, it is

expected that the number of in-migrant population from other regions in Tanzania will increase outside DSM within 50km from CBD rather than at urban fringe of DSM. If we assume the following possible population growth, the population at surrounding wards of DSM which are located within 50km radius from the CBD will be about 3,000,000. The assumed population growth rate between 2017 and 2040 for each wards of Greater DSM are illustrated in Figure 8.1.3

1) Population growth rate is 10.64% for the wards near the border of DSM and along the main roads (10.64% is average annual population growth rate of urban fringe wards of DSM between 2002 and 2012).
2) Population growth rate is 5.60% for the wards far from the boarder of DSM and along the main roads (5.60% is average annual population growth rate of the whole DSM between 2002 and 2012)
3) Population growth rate is 2.17% for the wards distant from the main roads (2.17% is average annual population growth rage of Pwani Region between 2002 and 2012)

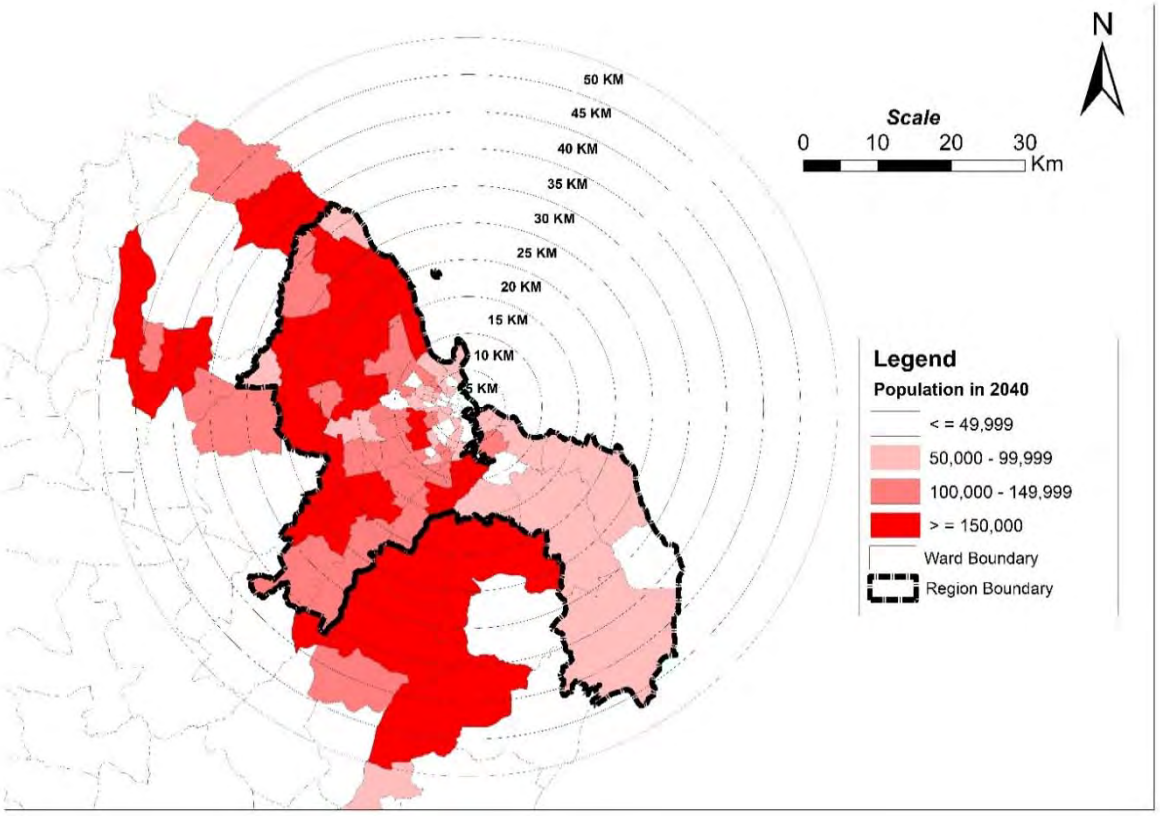
Only for the wards of Kisarawe district, 5.60% is applied to the wards near the border of DSM and along the main roads and 2.17% is applied to other wards. Pugu Forest Reserve and Ruvu South Forest Reserve lie in the district even at the boarder of DSM, so even the current population density of Kisarawe ward, district centre, is smaller than other districts. It is expected that population growth rate in the district is smaller than that in other districts.



Source: JST

Figure 8.1.3 Assumed Population Growth Rate between 2017 and 2040 for Greater DSM

Figure 8.1.4 shows population distribution of Greater DSM as of 2040, when population of Greater Dar es Salaam reach 15,000,000.



Source: JST

Figure 8.1.4 Population Distribution of Greater DSM as of 2040

8.1.2 Working Population at Resident Place (Night-Time Population)

Working population at resident place for each ward is calculated with the following steps.

1) Total working population at resident place in 2017 is projected based on the data of working population in 2012 in "Basic Demographic and Socio-economic Profile Dar es Salaam Region (2016)".

2) Estimated working population at resident place in 2017 through "traffic survey" conducted in this study is adjusted to have the same number as the total working population projected above (1).

3) Working population at resident place in 2040 is estimated by assuming that the share between working population and residential population as of 2017 will be the same in 2040 and multiplying residential population in 2040.

8.1.3 Working Population at Working Place (Day Time Population)

Working population at working place is calculated with the following steps. It is assumed that working population at working place is the same as working population at residential place.

1) D/N for each zone of "CBD", "CA","CR", and "NC" mentioned in Table 8.1.2 is set by referring to current Day-Time/Night-Time Ratio (D/N) obtained in the traffic survey.

2) Working population at working place for 90 wards is tentatively estimated by multiplying working population at resident place by D/N set above (1).

3) Sum of tentative working population at working place for the wards located "CR" and "CA" is obtained by subtracting working population at working place for the wards located in "CBD" and "CA" from tentative working population at working place for 90 wards.

4) Sum of working population, which should be at working place for the wards located "CR" and "CA", is obtained by subtracting working population at working place for the wards located in "CBD" and "CA" from working population at resident place for 90 wards.

5) D/N for the wards located "CR" and "CA" is adjusted to make the sum of tentative working population at working place for the wards located "CR" and "CA" equal to the sum of working population, which should be at working place for the wards located "CR" and "CA".

6) Working population at working place for the wards located "CR" and "CA" is obtained by multiplying working population at resident place for the wards located "CR" and "CA" by adjusted D/N.

Future population, working population at residential place, and working population at working place for 90 wards mentioned above (1) to (3) are used in Future Transport Demand Forecast as the inputs for "Variable (X)" to be mentioned in Sub-chapter 8.2.2.

8.2 Future Transport Demand Forecast

8.2.1 Framework of Transport Demand Forecast

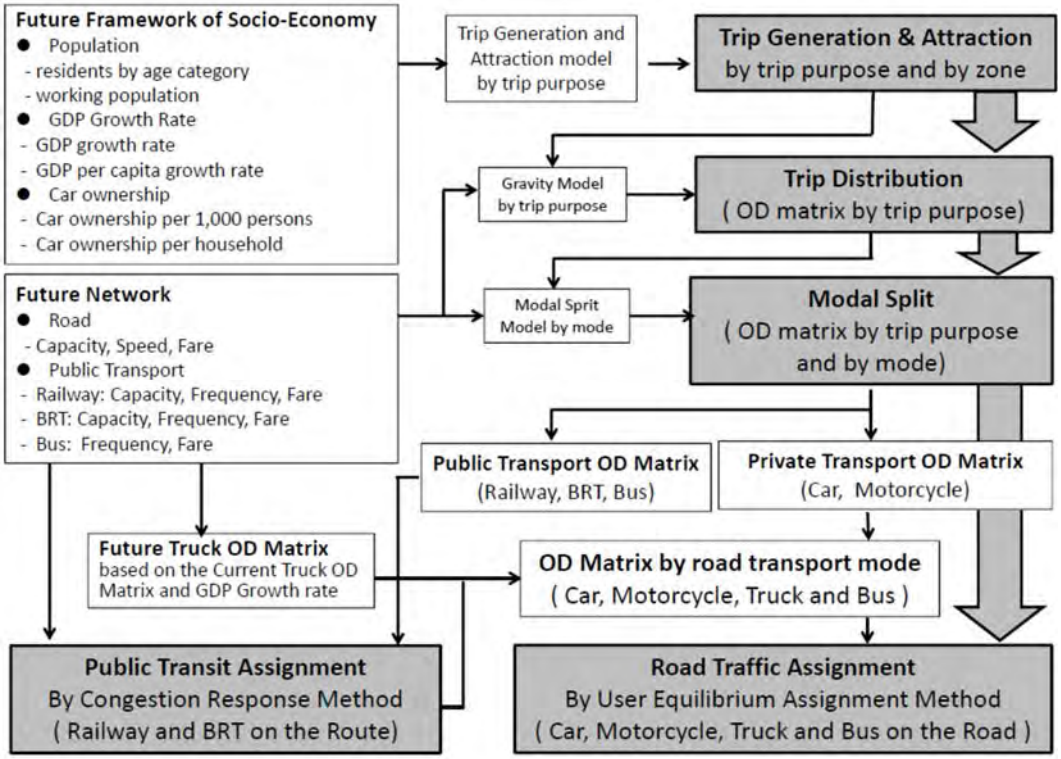
(1) General Work Flow of Transport Demand Forecast

The general work flow of transportation demand forecast in this project is shown in Figure 8.2.1.

In terms of big changes in circumstances surrounding the transportation of DSM, the expansion of DSM metropolitan area (daily commuting area) and the increase of vehicle ownership are considered to have changed and even continue to change in the next twenty years. It is required to build a transportation demand model which can reflect these changes simply and easily understandable.

In Future Framework of Socio-Economy in Figure 8.2.1, for the sake of simplifying and making understandable explanation of the relationship between the transition of vehicle ownership and changes in traffic demand, vehicle ownership model shall be developed to divide private vehicle owner and non-owner prior to the Modal Split Modelling in Four-Step transportation demand forecast. This makes it easier to review and adjust the future plan by watching the actual trend of vehicle ownership in future. However, specific transportation demand model shall be decided after the analysis of the identification of estimated model parameter from the data obtained by HIS and cordon line survey which was held in 2017.

The future transport demand forecast was conducted by using the four steps procedure, which is popular in the field of transport demand forecast at the moment. The procedure consists of four steps of 1. Trip Generation/Attraction, 2. Trip Distribution, 3. Modal Split and 4. Traffic Assignment as shown in Figure 8.2.1



Source: JST

Figure 8.2.1 General Work Flow of Transport Demand Forecast

(2) Zoning System

The study area is divided into 90 zones, which is as same as wards for the population census in 2012. Most of the analysis including model building of future demand forecasting are based on the 90 zones system. It should be mentioned that 100 outside zones are added in this Study to the existing zone system for traffic assignment, which are wards in neighbouring regions and cities outside of Dar es Salaam.

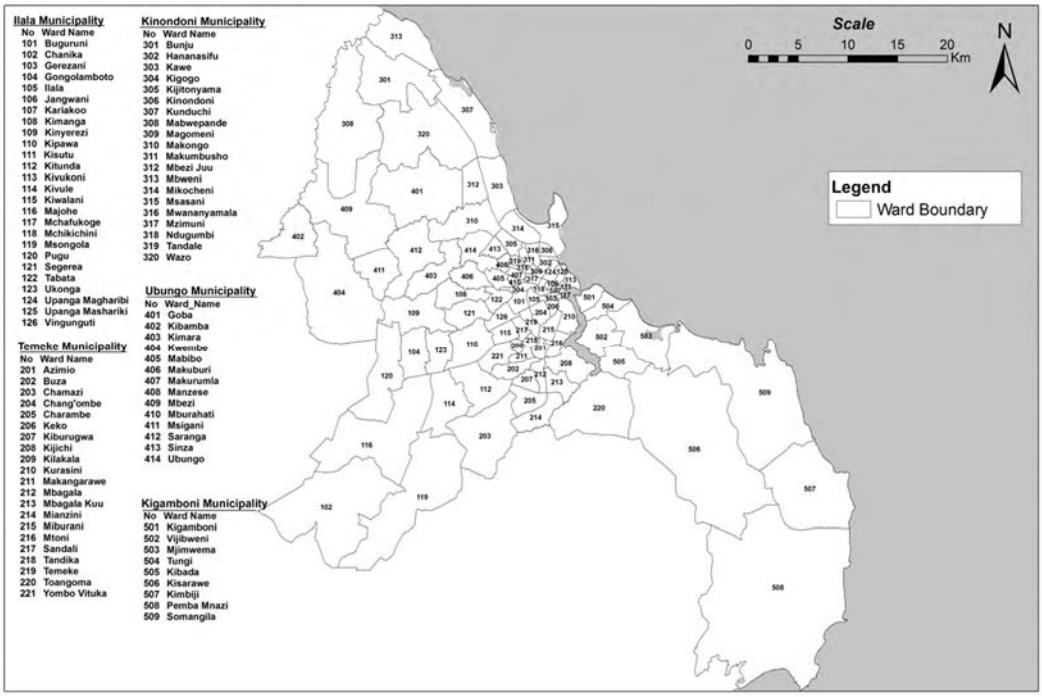


Figure 8.2.2 Zones for Demand Forecasting in Dar es Salaam

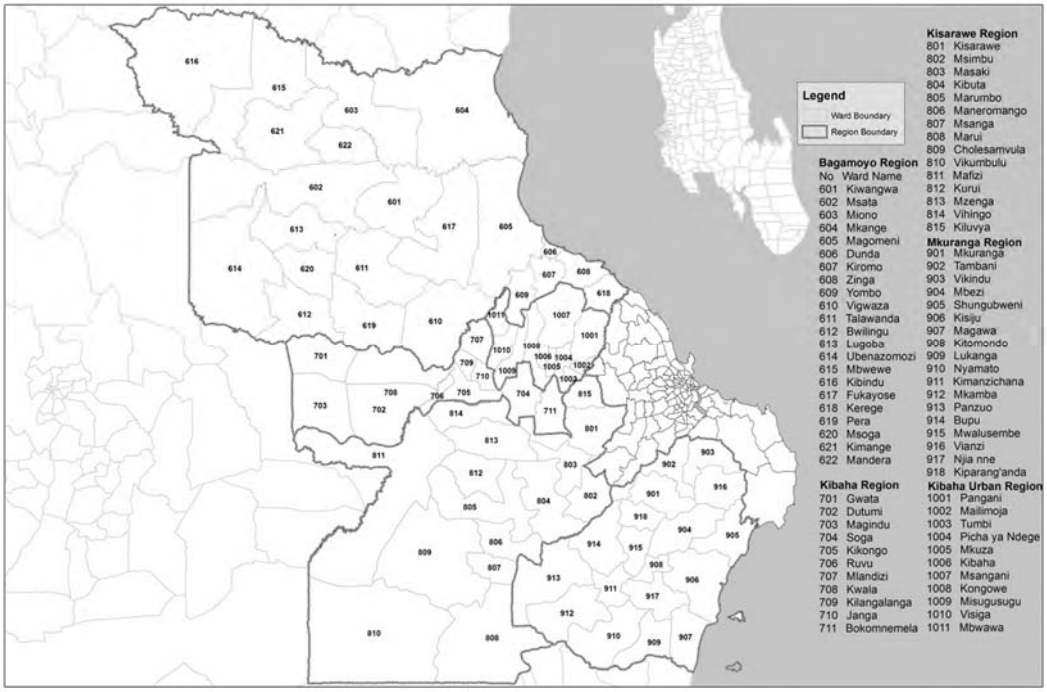


Figure 8.2.3 Zones for Demand Forecasting outside of Dar es Salaam

(3) Trip Purpose

In the transport demand forecast, trip purpose is divided into five categories as shown in Table 8.2.1.

Table 8.2.1 Trip purpose Categories in Demand Forecasting

	Trip Purpose Categories
1	To work
2	To School
3	Business
4	Private / Others
5	To Home

(4) Travel Mode

In the transport demand forecast, six travel mode categories are used as shown in Table 8.2.2.

Table 8.2.2 Travel Mode Categories in Demand Forecasting

	Travel Mode Categories	Remarks
1	Walk / Bicycle	Non-Motorized Trip
2	Motorcycle	Private Mode
3	Car	Private Mode
4	Bus	Public Mode
5	BRT	Public Mode
6	Railway	Public Mode

For the process of the Road Traffic Assignment, six vehicle categories are used as shown in Table 8.2.3.

Table 8.2.3 Vehicle Type Categories in Road Traffic Assignment

	Vehicle Type
1	Motorcycle
2	Car
3	Bus
4	2 Axle Truck
5	3 Axle Truck
6	Heavy Truck

(5) Level of Service (LOS) by Mode

a) LOS of Road Based Transport

Several conditions relating to the level of service of the existing or future transportation network were examined to forecast the future transport demand. The following assumptions on road traffic capacities and velocities are presented in Table 8.2.4.

Table 8.2.4 Level of Service of Road Based Transport in Demand Forecasting

a. Capacities and Velocities

Category	Capacity after Traffic Management in 2040 (pcu/lane)	Maximum Speed (km/h)	Remarks
Expressway	20,000	100	20TZS/km for toll road
Middle Ring road	11,000	80	
Arterial Roads in CBD	8,000	60	Morogoro, Bagamoyo, Nyerere, Kilwa
Arterial Roads outside CBD in Strategic Traffic Management Area within Nelson Mandela road	9,000	60	Morogoro, Bagamoyo, Nyerere, Kilwa, Nelson Mandela
Arterial Road outside Nelson Mandela road	11,000 : within Middle Ring 12,000 : outside Middle Ring	65	Morogoro, Bagamoyo, Nyerere, Kilwa, Outer Ring
Other roads in Strategic Traffic Management Area	4,000 : in CBD 5,000 : outside CBD	30	
Other roads outside Nelson Mandela road	5,500 : within Middle Ring 6,000 : outside Middle Ring	35	
Other roads, not paved	4,000	30 : within Nelson Mandela 35 : outside Nelson Mandela	

Source: JST

b. Price of Gasoline for Car/Motorcycle Users

To work	To School	Business	Private	Remarks
100.2 TZS/km	75.3 TZS/km	98.4 TZS/km	89.1 TZS/km	Assumed by the current share of car and motorcycle by purpose Petrol price: 1,978TZS/litter Fuel efficiency: Car:13km/litter, Motorcycle: 39km/litter

Source: JST

b) LOS of Public Transport

Assumptions on road traffic capacities and velocities are presented in Table 8.2.5.

Table 8.2.5 Level of Service of Public Transport in Demand Forecasting

a. Velocities and Others Relating Operation

Category	Average Station distance interval (m)	Average Speed (km/h)	Headway (minute)	Remarks
Railway (MRT)	Loop line: 2,000 Others: 3,000	35 : within Nelson Mandela road 40 : within Middle Ring road 45 : outside Middle Ring road	5 Excluding Pugu line and TAZARA railway	Pugu line and TAZARA railway are assumed to be operated by 30min.interval in the future
BRT	500	20	2	
Bus including Daladala	Less than 500	10	No waiting time	
Express Bus	Not existed	100 : Expressway 60 : Middle Ring road	30 : Expressway 10 : Middle Ring road	

Source: JST

b. Fares

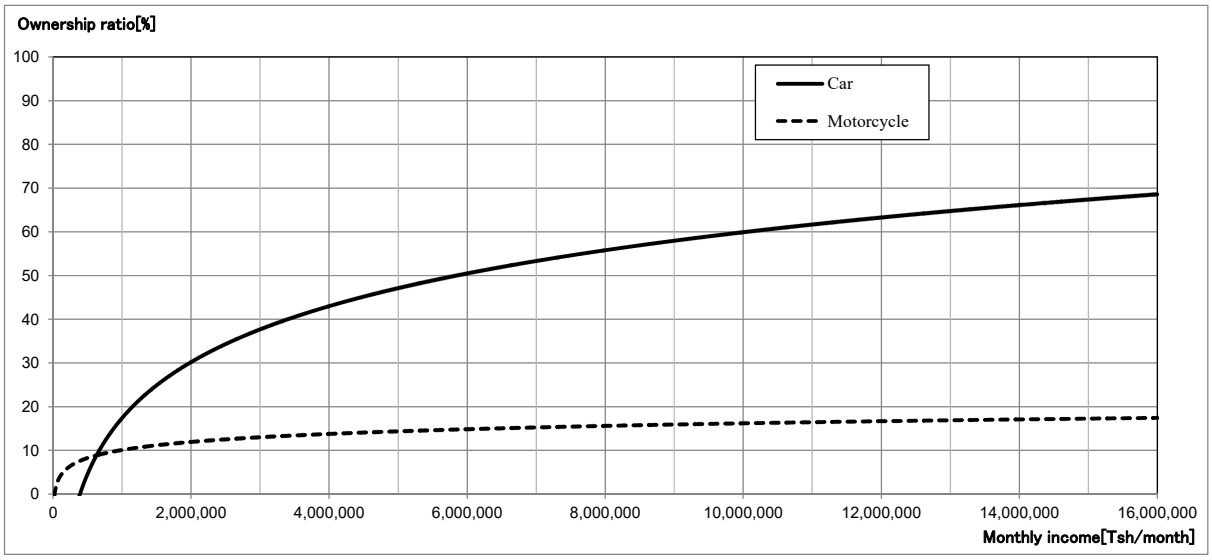
Category	Current fare	Future fare	Remarks
Railway (MRT)	30 TZS/km *Half for Student	750 TZS within 10km 750 Plus 20 TZS/km for more than 10km *Half for Student	e.g. 950 TZS for 20km Highest fare among public transport modes
BRT	650 TZS as flat fare *Half for Student	650 TZS within 10km 650 Plus 10 TZS/km for more than 10km *Half for Student	e.g. 750 TZS for 20km
Bus including Daladala	0-10km 400 TZS 11-15km 450 TZS 16-20km 500 TZS 21-25km 600 TZS 26-30km 750 TZS *Half for Student	Same as current fare	e.g. 500 TZS for 20km
Express Bus on the expressway as intercity service	Not existed	Same as railway in the future *Half for Student	

Source: JST

It should be noted that the public transport system is an integrated mode, which consists of the Railway (MRT), BRT and bus services. The existing bus services are used as the access/egress transport to support the other transport system. For example, passengers would use the existing bus (access mode) first, then Railway and/or BRT next, and finally would use the existing bus (egress mode). Therefore, it could be said that the public transport system is the combination of the three modes. Fare is calculated by of the total of each public transit used for the trip. Travel time is the total of the combination of the modes, including waiting time for transfer.

(6) Vehicle Ownership

Vehicle ownership greatly affects a person's decision on choosing their mode of travel. Vehicle ownership ratio in 2017 is estimated based on the household interview survey in 2017. Figure 8.2.4 indicates distribution of vehicle ownership by household income level. The ownership in 2040, which is the final target year of this Study, is estimated by the Study Team as shown in Table 8.2.6.

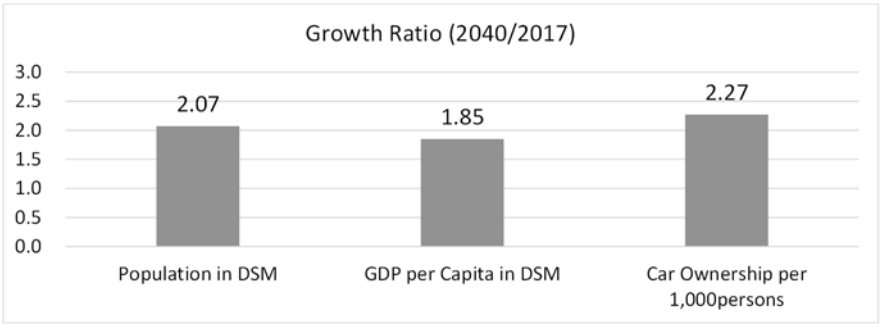


Source: JST

Figure 8.2.4 Vehicle Ownership by Household Income

Table 8.2.6 Vehicle Ownership Rate per 1,000persons in DSM

Item	2017	2040	Growth Rate (2040/2017)
Population	5.8 million in DSM	12 million in DSM	2.07 times
		15 million in Greater DSM	2.59 times
GDP Growth Rate in TZ	7%	6%	3.82 times
GDP per capita in DSM	3.4 million TZS	6.3 million TZS	1.85 times
Average Monthly Income of Household	847,396 TZS	1,567,683 TZS	1.85 times
Car ownership per 1,000pesons	33 vehicles per 1,000persons	75 vehicles per 1,000persons	2.27 times



Source: JST

Figure 8.2.5 Growth Ratio of Population, GDP per Capita and Car ownership

(7) Forecast Cases

1) Target Year

Target year of 2040 is assumed for future traffic demand forecast, which corresponds to target year of the master plan including road development planning, public transit planning and urban structure planning. The case of 2030 is also examined, and the result is shown in the chapter 13.

2) Simulation Cases

To measure the transport effectiveness of the Master Plan, four simulation cases are set up as shown in Table 8.2.7. Master Plan Case includes development of urban structure, BRT, Rail and Road network. On the other hand, Do-nothing Case includes only existing planned development such as BRT Phase1-4. By comparing these two cases, the effectiveness of the Master Plan can be evaluated. Alternative Case is the same as Master Plan Case except for Rail development. Therefore, the effect of Rail development can be evaluated by comparing the two cases.

Table 8.2.7 Simulation Cases for Demand Forecast

	Case Name	Forecast Year	Urban Structure	Public Transport	Road Network
1	Current Condition	2017	Current Condition	Current Service BRT: Phase1 Rail: Pugu, Ubungo, TAZARA lines	Current Network
2	Do-nothing Case	2040	Trend	Current Service BRT: Phase1-4 Rail: Pugu, Ubungo, TAZARA lines	Current Network
3	Alternative Case		Balanced Structure with Satellite Cities & Sub centres	BRT: Phase1-6+α Rail: Current lines	Current Network + Missing Link Completion (Middle Ring Road, etc.)
4	Master Plan Case		Balanced Structure with Satellite Cities & Sub centres	BRT: Phase1-6+α Rail: Current + New lines (Loop, Bagamoyo, Morogoro)	Current Network + Missing Link Completion (Middle Ring Road, etc.)

Source: JST

8.2.2 Transport Demand Forecast

(1) Trip Generation and Attraction

a) Trip Generation Rate and Vehicle Ownership

In general, trip generation and vehicle ownership have a close relationship with each other. In this Study, the relationships are examined and the trip rates are shown in Table 8.2.8. It is clear that vehicle owners have higher trip rates compared to non-owners.

Table 8.2.8 Trip Generation Rate by Vehicle Ownership

Ownership	Trip Rate	2017	
		Population	Trips
No Vehicle	1.50	4,763,936	7,165,509
MC or Car	1.87	1,011,193	1,894,004
Total	1.57	5,775,129	9,059,513

Source: JST

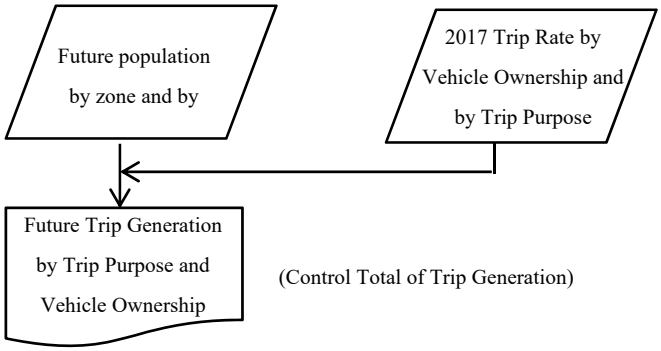
b) Vehicle Ownership Analysis

Vehicle ownership analysis is done based on the Home Interview Survey results. In the analysis, relationship between vehicle ownership and average monthly household income is examined. Average monthly household income in 2040 is estimated by assuming that it grows as the same rate

as GDP. Then, future population by vehicle ownership category is forecasted by traffic zone.

c) Future Trip Generation

Future total trip generation in 2040 is forecasted by using the procedure shown in Figure 8.2.6. It is assumed that future trip rate by vehicle ownership and by trip purpose is same as the rates in 2017.



Source: JST

Figure 8.2.6 Flow Chart of Future Total Trip Generation

d) Trip Generation and Attraction Model

This Study adopts the trip generation and attraction model which is shown below.

$$Y^{i}_{k} = a_{k} * X^{i}_{k}$$

Where,

i : Zone Code,
k: Trip Purpose,
Y^{i}_{k} : Trip Generation or Attraction of k purpose in i-zone,
X^{i}_{k} : Variable of k purpose in i-zone
a_{k} : Parameter of k purpose

The model consists of 8 models as shown in Table 8.2.9.

Table 8.2.9 Trip Generation and Attraction Model by Trip Purpose

	Trip Purpose	Variable (X)	Result of Analysis		
			Parameter (a)	T-value	Coefficient of determination
Production Trip	To work	Working population at Resident place	0.7877	96.672	0.991
	To School	Population from 5-year to 24-year ages	0.6812	154.775	0.996
	Business	Working population at Work place	0.1011	23.333	0.859
	Private / Others	Population	0.1584	31.390	0.917
Attraction Trip	To work	Working population at Work place	0.8670	79.272	0.986
	Business	Working population at Work place	0.1430	26.344	0.886
	Private / Others	Working population at Work place	0.5005	28.349	0.900

Source: JST

It should be noted that “To School” trip attraction model is not developed. It was impossible to obtain appropriate parameter to represent the number of attraction trips. It seems that this is because

the number of students at each zone is not decided by variables such as population of 5-24 year ages, but decided by the location and the number of schools of the zone. In other words, attraction trips should be reflected by existence of school. In order to represent it, the following procedure is applied. First, the future ratio of students by zone is assumed to be the same as the current ratio, although the future number of student is expected to be bigger than current number. Second, all production trips to school are distributed to each zone as attraction trips based on the ratio.

"To Home" trips are estimated by assuming that the opposite direction trips of "To work" and "To School". Also, a part of "Others" trips are considered as the "To Home". So, the part of opposite direction of "Others" trips are added to the "To Home" so that summation of all purposes can match the control total volume.

e) Future Trip Generation and Attraction

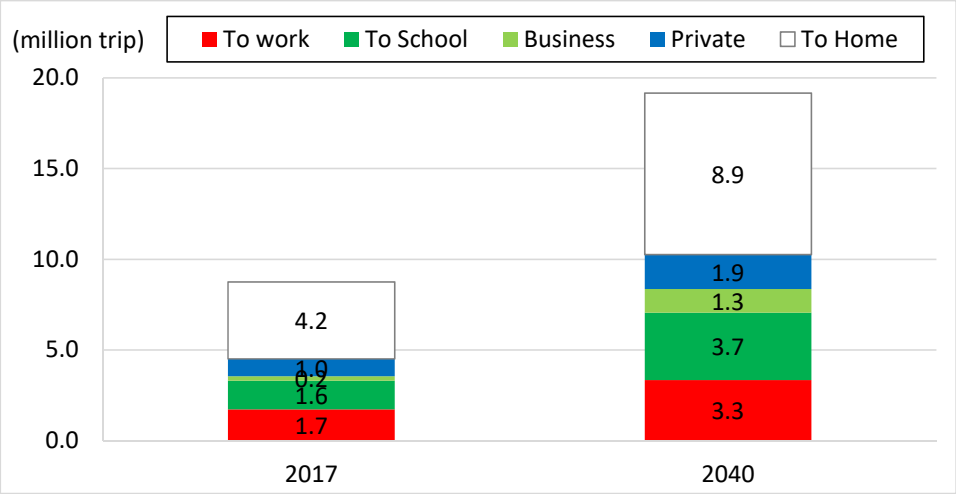
Future trip generation and attraction by trip purpose and by zone are estimated by using the models mentioned above. Total generated and attracted trips are adjusted to the Estimated Trip Generation Total in the target years, which is shown in Table 8.2.10 and Figure 8.2.7. Number of trips generated in 2040 is estimated at approximately 19.2 million, which is more than twice the trips in 2017.

Table 8.2.10 Future Trip Generation in 2040

(Unit: million person trips/day)

Purpose	2017 (a)	2040 (b)	Growth Rate (b/a)
To work	1.7	3.3	1.9
To School	1.6	3.7	2.4
Business	0.2	1.3	5.4
To Home	4.2	8.9	2.1
Private/Others	1.0	1.9	2.0
Total	8.8	19.2	2.2

Source: JST



Source: JST

Figure 8.2.7 Estimated Trip Generation Total in 2040

(2) Trip Distribution

To estimate future inter-zonal trips, the gravity models by trip purpose are adopted, because the Study Team assumed that drastic land use changes and extensive urban development within the Study Area would happen in the future. Future trip distribution is estimated based on the above trip generation/attraction and the gravity models as shown below.

$$T_{ij} = K \cdot \frac{G_i^{\alpha} A_j^{\beta}}{D_{ij}^{\gamma}}$$

Where,

i, j: zone

Tij: number of trips between zone i and zone j

Gi: number of trips generated in zone i

Aj: number of trips attracted in zone j

Dij: travel time (min) on the road between zone i and zone j

K, α, β, γ: parameter

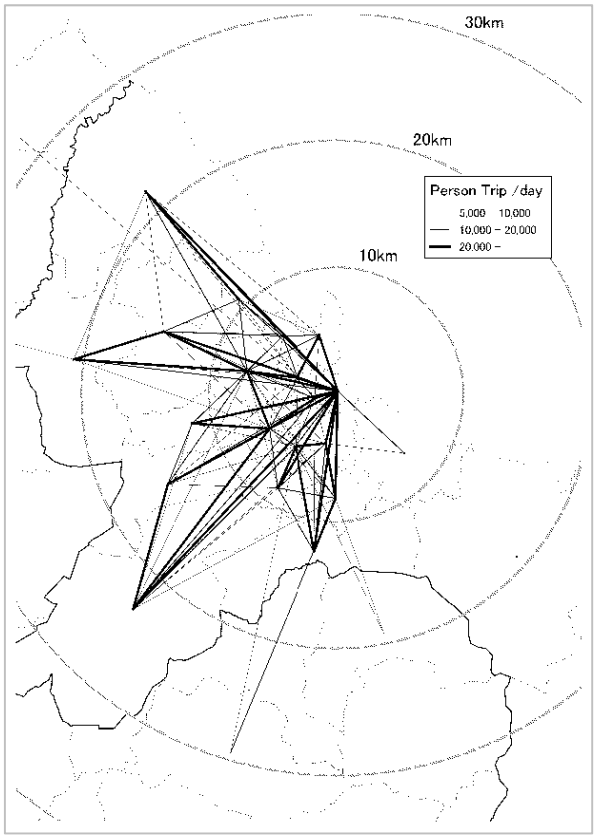
Table 8.2.11 Trip Distribution Model (Gravity Model)

Purpose	Parameters (t-value)				Multiple Correlation Coefficient
	α	B	γ	K	
To work	0.4879 (10.604)	0.4506 (18.244)	0.8758 (26.547)	68.488 (15.167)	0.652
Business	0.2990 (10.869)	0.2930 (13.848)	0.3821 (11.321)	91.281 (29.440)	0.620
Private, Other	0.4227 (11.176)	0.4230 (18.987)	0.7362 (25.214)	64.117 (18.993)	0.628

Source: JST

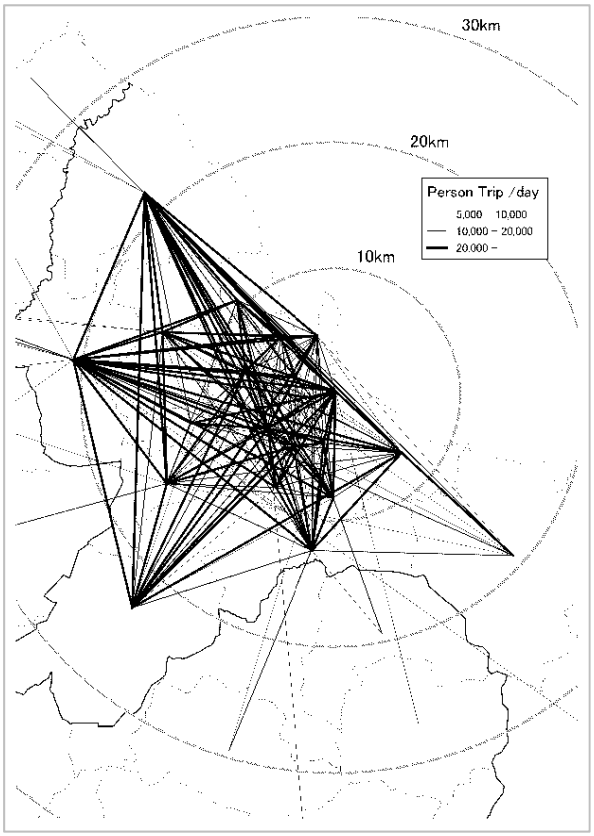
The gravity models are used to estimate future travel patterns in the area in the target years. Future trip distributions by trip purpose are estimated by the Frater Method based on the estimated trip pattern by the gravity model and the future trip generation/attraction.

Figure 8.2.8 shows the desire line in the Study area in 2017, while Figure 8.2.9 shows that of 2040. These figures are drawn based on the estimated origin-destination total trips. Figure 8.2.10 shows share of CBD trips, in which either origin/destination is CBD area, in “To work” trips. It can be said that the ratio decreases in 2040 by the development of balanced structure with Satellite Cities & Sub-centres.



Source: JST

Figure 8.2.8 Desire Line of Trips between Zones in 2017



Source: JST

Figure 8.2.9 Desire Line of Trips between Zones in 2040

No. of Trips (person trips/day)

CBD Trips:	326,000	394,000
Total Trips:	1,730,000	3,341,000

Source: JST

Figure 8.2.10 Share of CBD Trips in "To work" Category

Figure 8.2.11 shows average trip distance of 2017 and 2040. Trip length in 2040 will become longer than that of 2017 by 2.0km, which is corresponds to 22%.

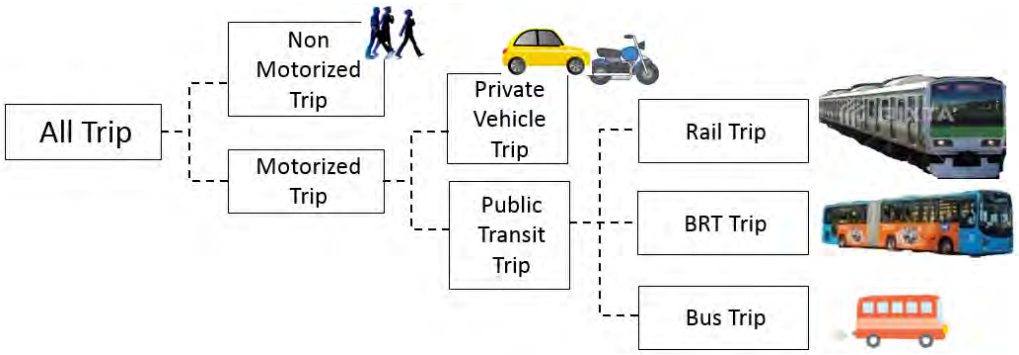
Source: JST

Figure 8.2.11 Average Trip Distance of 2017 and 2040

(3) Modal Split

a) Modal Split Hierarchy

The modal split hierarchy for the model building process in this Study is shown in Figure 8.2.12 below. First, a model which divides transport demands (trips) into "Motorized Trip" and "Non-Motorized Trip" shall be built. Second, motorized trip shall be divided into "Private Vehicle Trip (including motorcycle)" and "Public Transit Trip" by developing a modal split model. Transport demand by each transportation mode shall be estimated through the public transit assignment.



Source: JST

Figure 8.2.12 Modal Split Hierarchy

b) Modal Split Model between Motorized Trip and NMT

Regarding the modal split between the motorized and non-motorized trips, the model as shown in the following formula is adopted. The share of walk and bicycle among all modes between zones is determined by trip length.

$$P_{ij} = \frac{1}{1 + \alpha \cdot D_{ij}^{\beta}}$$

Where,

i, j: zone

Pij : share of walk and bicycle between zone i and zone j

Dij: distance (km) on the road between zone i and zone j

α, β: parameter

Table 8.2.12 Modal Split Model between Motorized Trip and NMT

Purpose	Parameter (t-value)		Multiple Correlation Coefficient
	A	β	
To work	0.1380 (-76.536)	2.2278 (129.798)	0.972
To School	0.0721 (-127.298)	1.9443 (169.944)	0.983
Business	0.3652 (-55.710)	2.1528 (174.847)	0.984
Private / Other	0.0218 (-678.776)	3.1295 (611.745)	0.999

Source: JST

c) Modal Split Model between Private Vehicle and Public Transit

A disaggregate logit model is developed to estimate the split between the private vehicle and the public transit by trip purpose. In this model, travel distance and car ownership are used as explanatory variables.

$$\boldsymbol{P_{car} = \frac{e^{V_{car}}}{e^{V_{car}} + e^{V_{mas}}}} \quad , \quad \boldsymbol{P_{mas} = 1 - P_{car}}$$

$$V^{car} = \alpha \cdot T + \beta \cdot R + \gamma \cdot PH_{mc} + \delta \cdot PH_{car} + \sigma, \qquad V^{mas} = \alpha \cdot T + \beta \cdot R$$

Where, Pcar : choice probability of private car use trip
Pmas : choice probability of public transit use trip
T: travel time (min), R: cost
PHmc: motorcycle ownership, PHcar: car ownership
α, β, γ, δ : parameter, σ : car dummy

Table 8.2.13 Modal Split Model between Private Vehicle and Public Transit

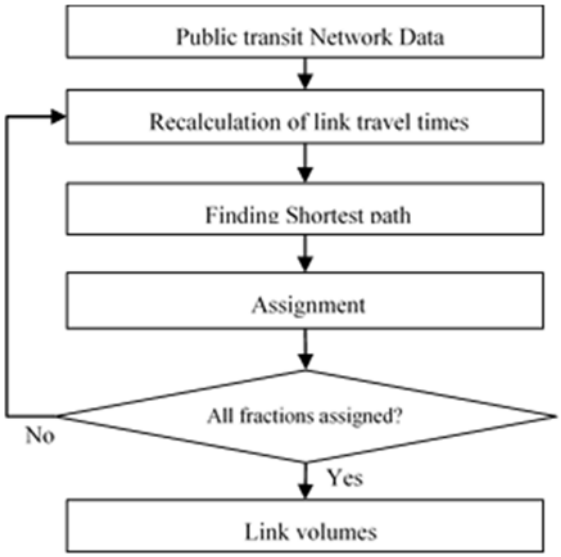
Purpose	Mode	Time (min) α	Cost (TZS) β	Motor-cycle ownership γ	Car ownership δ	Car Dummy σ	Likelihood ratio index	Hit rate (%)	Number of samples
To work	Public transit	-0.0209 (-10.264)	-0.0004 (-5.923)				0.250	77.6	5,927
	Private vehicle			1.6614 (18.134)	2.5149 (31.840)	-1.5306 (-20.988)			
To School	Public transit	-0.0259 (-2.831)	-0.0012 (-2.329)				0.127	68.7	351
	Private vehicle			0.8145 (2.179)	1.6623 (6.104)	-1.1815 (-4.545)			
Business	Public transit	-0.0320 (-6.742)	-0.0006 (-4.442)				0.187	72.6	1,178
	Private vehicle			1.7762 (9.443)	1.7912 (9.974)	-1.4667 (-8.629)			
Private / Other	Public transit	-0.0089 (-3.181)	-0.0003 (-2.731)				0.128	68.2	2,034
	Private vehicle			1.1336 (7.443)	1.8482 (14.379)	-0.7626 (-7.103)			

Source: JST

d) Modal Split Model among Rail, BRT and Bust

Regarding the modal split among rail, BRT and bus, future trips are forecasted by using the procedure shown in Figure 8.2.13. In the procedure, fractions of traffic volumes are assigned in steps. First, fraction of OD demand is assigned on the shortest path based on all-or-nothing assignment. After assignment, link travel times are recalculated based on link volumes. This process continues repeatedly until all OD demand is assigned.

In the procedure, travel time, fare and congestion are explanatory variables. Fare and congestion, which means seat occupancy, which reflects on the degree of discomfort, are considered as the equivalent value of time in the procedure. In the calculation, the equivalent value of time is assumed to be 60 TZS/min.



Source: JST

Figure 8.2.13 Flow Chart of Public Transit Assignment among Rail, BRT and Bus

In the model, discomfort in terms of time is given as link travel time multiplied by the coefficient, which is a function of congestion ratio. The coefficient is calculated as follows:

$$\boldsymbol{f_{cong} = f_{cong}(R) = \begin{cases} 0.0270R & (0 \le R < 1.0) \\ 0.0828R - 0.0558 & (1 \le R < 1.5) \\ 0.179R - 0.200 & (1.5 \le R < 2.0) \\ 0.690R - 1.22 & (2.0 \le R < 2.5) \\ 1.15R - 2.37 & (2.5 \le R) \end{cases}}$$

$$\boldsymbol{R = \frac{x_{pq}}{cap_{pq}}}$$

Where,

f_{cong}: coefficient of congestion discomfort

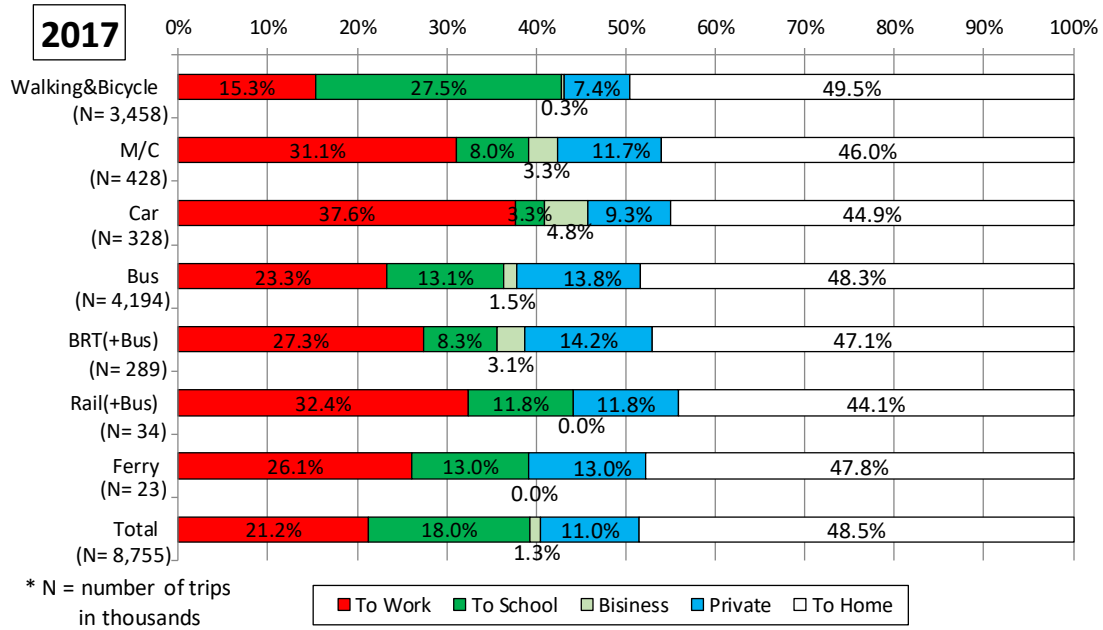
x_{pq} : link volume from station p to station q

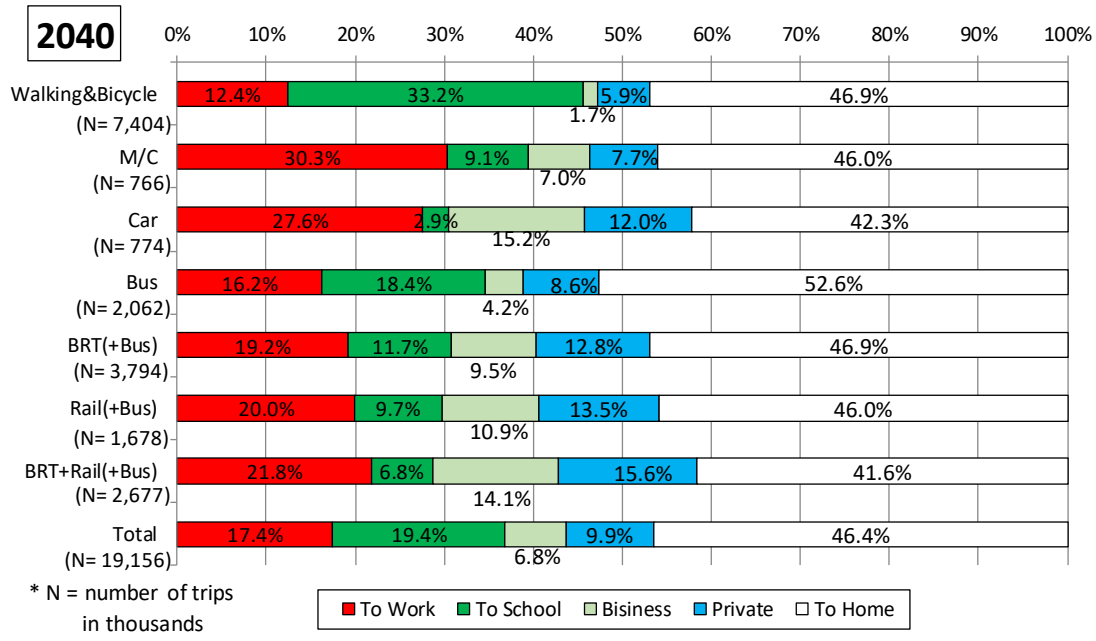
cap_{pq}: link capacity of station p to station q

e) Future Modal Split

Figure 8.2.14 shows share of trip purpose in each travel mode. Depending on the mode, share is different. For example, in Walking & Bicycle, To School is a major purpose. In Motorcycle, To Work is major. In Car, Business trip occupies a larger part than other modes. These characteristics are the same in 2017 and 2040.

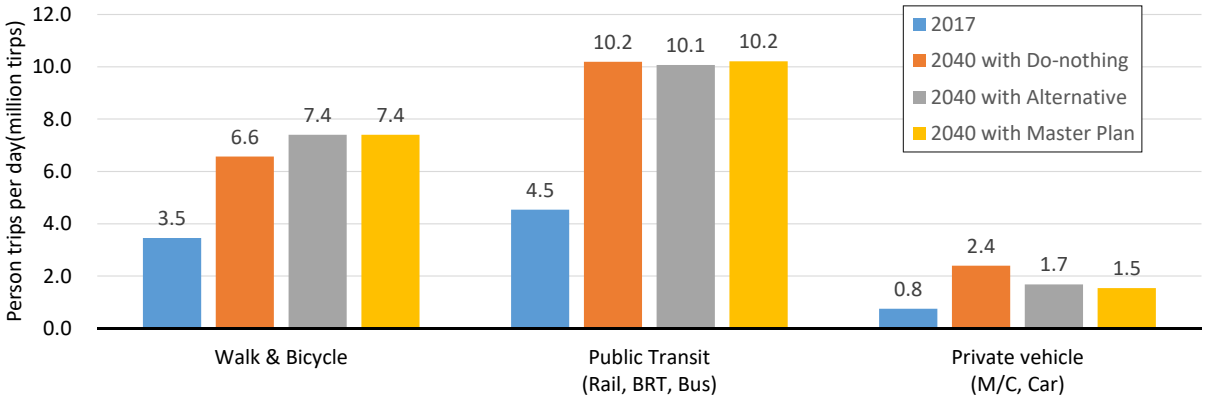
As shown in Figure 8.2.15, number of trips in 2040 cases increases in every mode of transport when compared to 2017. Private vehicle trips decrease with development of public transit. Figure 8.2.16 shows the share. In 2017, "Car" occupies 6.2%, while in Do-nothing Case, it occupies 11.2%. As shown in the next section, there is congestion all day along the whole road network in Do-nothing Case. But in Master Plan Case, increase of car trips is reduced to 6.6%. It can be said that rapid increase of car trips can be controlled by development of public transit.





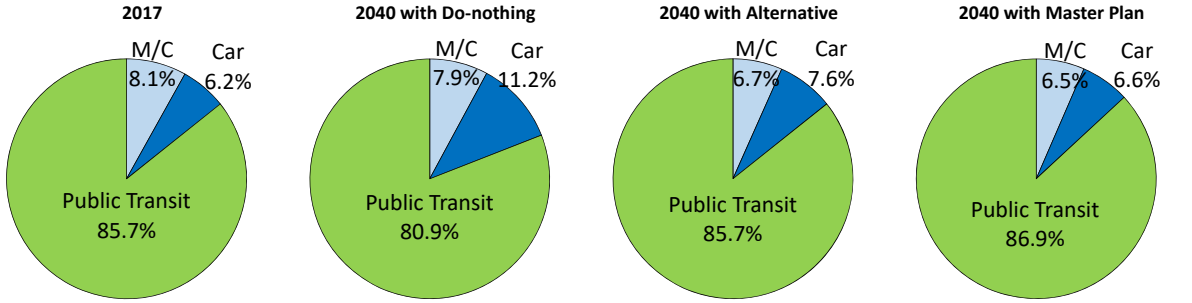
Source: JST

Figure 8.2.14 Trip Purpose by Travel Mode in 2017 and 2040 Master Plan Case



Source: JST

Figure 8.2.15 Comparison of Person Trips by Mode and by Case



(exclude NMT trips)

Source: JST

Figure 8.2.16 Share of Person Trips by Mode and by Case

Figure 8.2.17 shows share of travel mode by trip purpose. In public transit trips, people may use several modes. For example, they use Bus to get BRT station first and then transfer to BRT there. They might use both BRT and Rail. So, in the figure in 2040 Master Plan Case, public transit trips is divided into 4patterns, such as Bus only, BRT(+Bus), Rail(+Bus) and BRT+Rail(+Bus). From the figure, the share of BRT or Rail user can be obtained. For example, usage rate of Rail in "To work" is given by summation of 10.0% from Rail(+Bus) and 17.5% from BRT+Rail(+Bus), and it is 27.5%.

In 2040, ratio of BRT and Rail become bigger and occupy larger part than 2017 in all purposes. It means that both BRT and Rail will play important roles in public transportation.

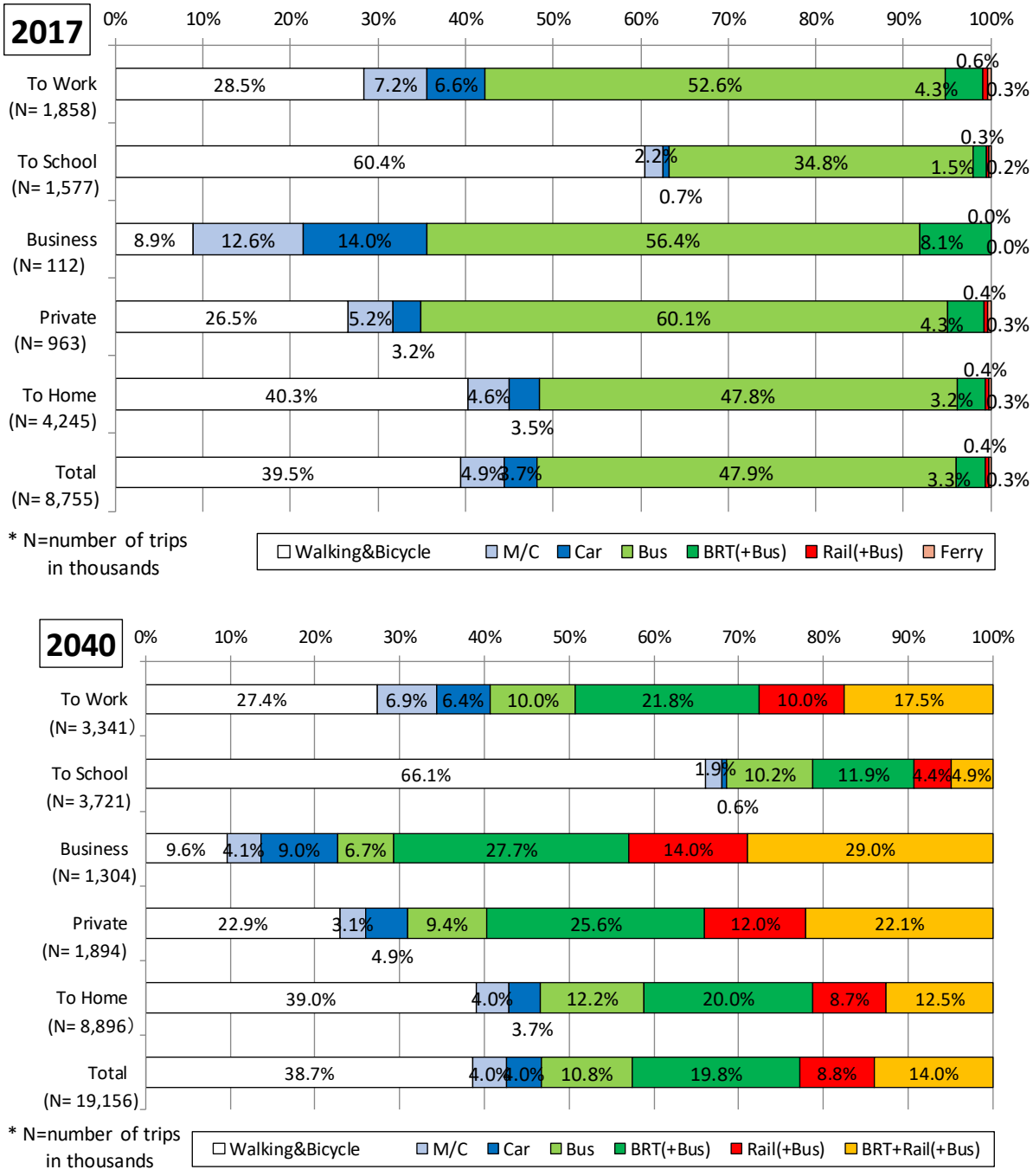


Figure 8.2.17 Travel Mode by Trip Purpose in 2017 and 2040 Master Plan Case

(4) Traffic Assignment

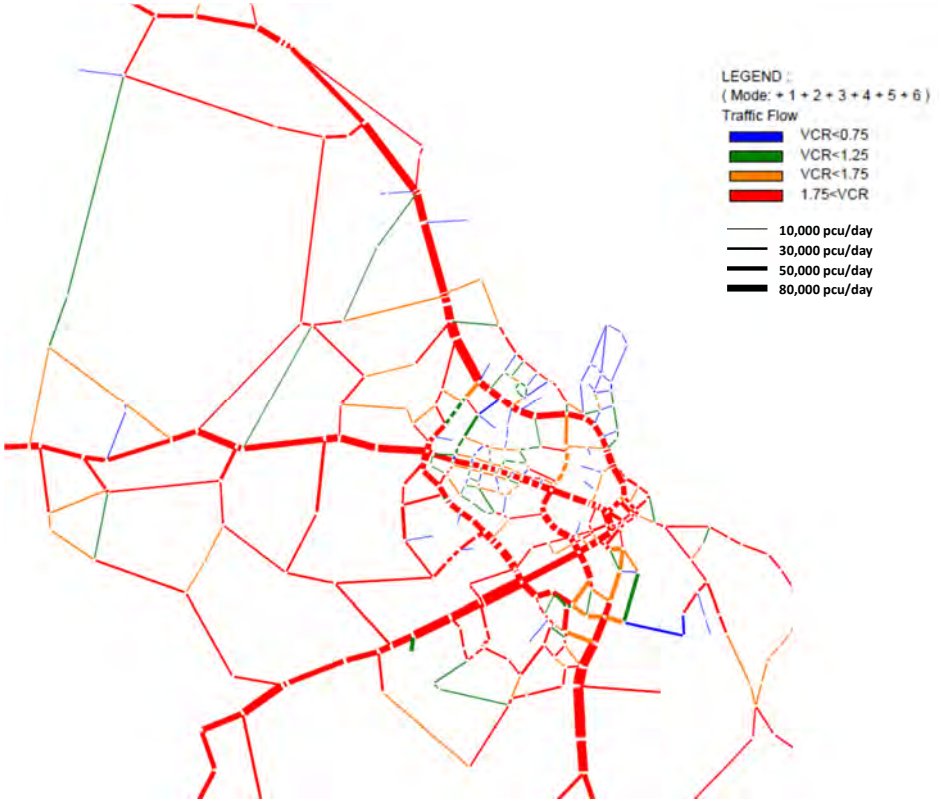
The Study Team uses the JICA STRADA model for the road vehicle traffic assignment. The User Equilibrium Traffic Assignment 3.5 of the model is used for this Study. The traffic assignment procedure is done by using future Vehicle OD tables and planned development in the target years. Results of the Assignment in cases in 2040 are shown in Table 8.2.14, Figure 8.2.18, Figure 8.2.19 and Figure 8.2.20.

Regarding the average travel speed of the road network in the study area, it is estimated as 10.7km/h, 28.5km/h and 30.9km/h in the Do-nothing, Alternative and Master Plan, respectively. With Master Plan development, average travel speed is improved by 20km/h. Effects of the development are clearly shown in the forecast results.

Table 8.2.14 Comparison of Congestion Ratio

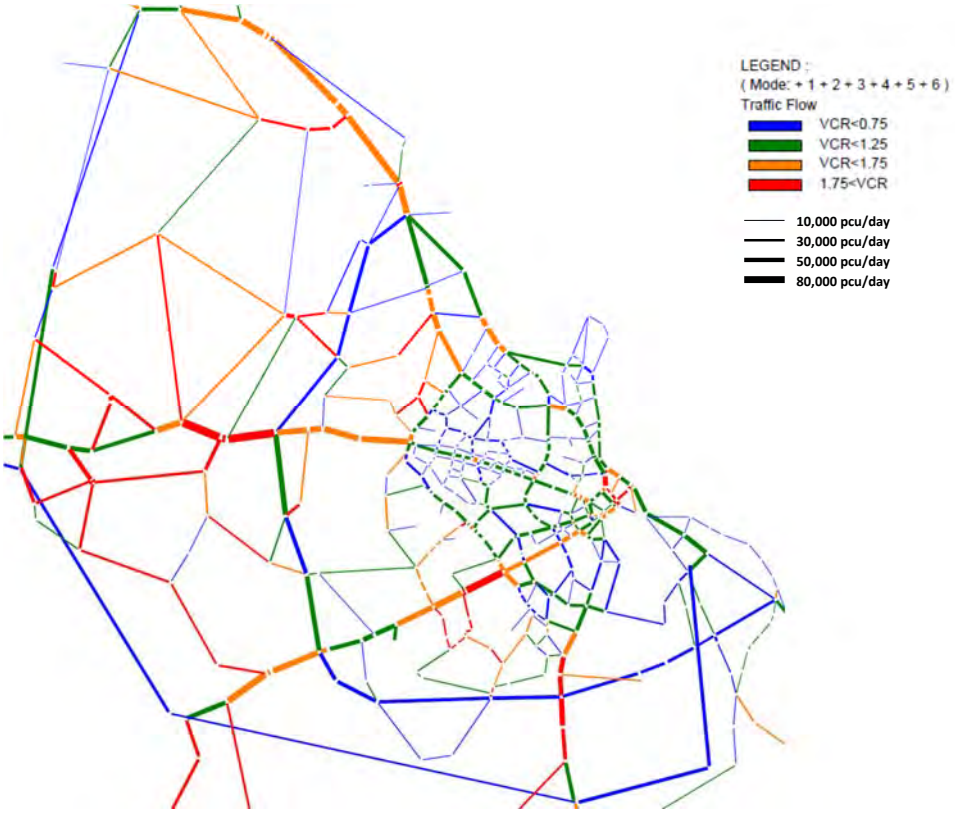
		2040_Do-nothing Case		2040_Alternative Case		2040_Master Plan Case	
Total vehicle kilometer		19,471,942		20,944,250		16,866,595	
Total vehicle time		1,811,605		734,934		545,036	
Average Congestion Ratio		1.97		0.76		0.61	
Average Speed (km/h)		10.7		28.5		30.9	
Road Length by Congestion Rank		Length (km)	Ratio	Length (km)	Ratio	Length (km)	Ratio
	Less than 0.75	183	0.22	518	0.50	602	0.58
	0.75 - 1.25	105	0.13	226	0.22	259	0.25
	1.25 - 1.75	126	0.15	152	0.15	86	0.08
	Over 1.75	403	0.49	145	0.14	94	0.09

Source: JST



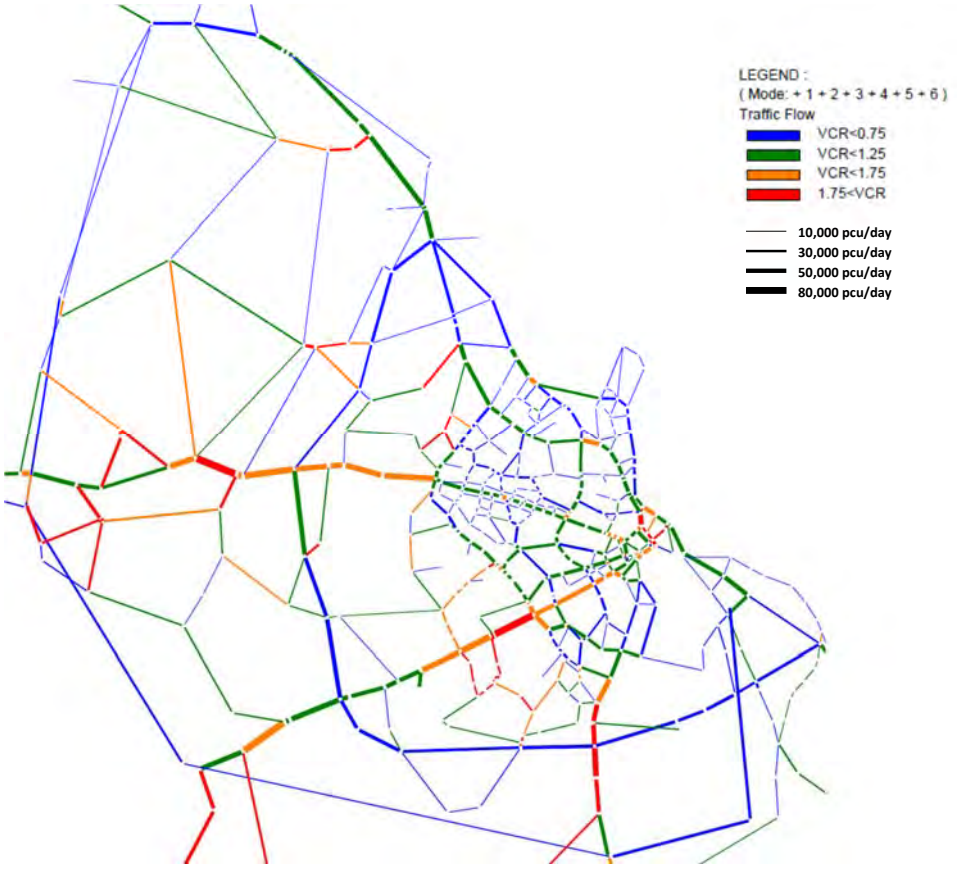
Source: JST

Figure 8.2.18 Traffic Volume in 2040 Do-nothing Case



Source: JST

Figure 8.2.19 Traffic Volume in 2040 Alternative Case



Source: JST

Figure 8.2.20 Traffic Volume in 2040 Master Plan Case

Transport assignment of the public transit is conducted by an all or nothing method based on the shortest path procedure by using the software developed by the Study Team. The assignment procedure is explained in previous section. Table 8.2.15 shows the daily passenger section volume of the Railway and the BRT in 2040 Master Plan case. Both MRT and BRT expect high demand even though both lines overlap along the same route. The volume of MRT passengers will be about twice of BRT passengers.

Table 8.2.15 Section Volume (Number of Passenger) in 2040 Master Plan Case

MRT	Section	No. of Passenger /day	PHPDT*
Loop Line	Central-Ubungo-Mwenge-Morocco	428,000 ～ 844,000	42,200
Bagamoyo Line	Mwenge-Bunju	673,000 ～ 1,029,000	51,450
Morogoro Line	Ubungo-Kimara	912,000 ～ 1,113,000	55,650

*PHPDT: Peak Hour Peak Direction Traffic

BRT	Section	No. of Passenger /day	PHPDT*
Phase-1	Morogoro Rd	251,000 ~ 522,000	26,100
Phase-2	Kilwa Rd	229,000 ~ 470,000	23,500
Phase-3	Nyerere Rd	164,000 ~ 379,000	18,950
Phase-4	Bagamoyo Rd	276,000 ~ 358,000	17,900
Phase-5	Nelson Mandela	160,000 ~ 317,000	15,850
Phase-6	Old Bagamoyo Rd	248,000 ~ 287,000	14,350

*PHPDT: Peak Hour Peak Direction Traffic

Source: JST

(5) Evaluation

Benefit from Master Plan Case is estimated by travel volume reduction and time saving. The value is calculated as approximately four billion US dollars per year. The details of the estimation are shown in chapter 12. Here in this chapter, based on bold assumptions, the benefit is roughly divided into three contributions of developments: urban structure strategy development, road development and rail development. The effect of each development is shown one by one.

a) Effect of Urban Structure Strategy Development

Figure 8.2.21 shows comparison of road traffic congestion situation in 2040 between Master Plan Case and the Case when the urban structure strategy development is not applied, in which other conditions such as rail, BRT and road networks are the same as in the Mater Plan case. When the urban structure strategy is not applied, road congestion spreads widely especially around CBD area.

Table 8.2.16 shows comparison of the traffic volume and trip distance. Traffic volume decreases by 13%, and average trip length decreases by 1.6km. Based on these values, the benefit of Urban Structure Plan development is estimated to be approximately 0.5 billion US dollars per year.

Without Urban Structure strategy development
<Master Plan Case without Urban Structure Plan>

Master Plan Case
<Master Plan Case>

Source: JST

Figure 8.2.21 Comparison of Road Congestion with/without Urban Structure Development

Table 8.2.16 Comparison of Traffic Volume and Trip Distance with/without Urban Structure Development

Total traffic volume (million persons/km)

Purpose	Without Urban Structure Plan	Master Plan Case	diff.
To Work	51.1	45.2	-6.0
To School	23.4	19.1	-4.4
Business	23.9	21.4	-2.5
Private	33.7	30.0	-3.7
To Home	108.0	93.3	-14.7
Total	240.1	209.0	-31.2

Average trip length (km)

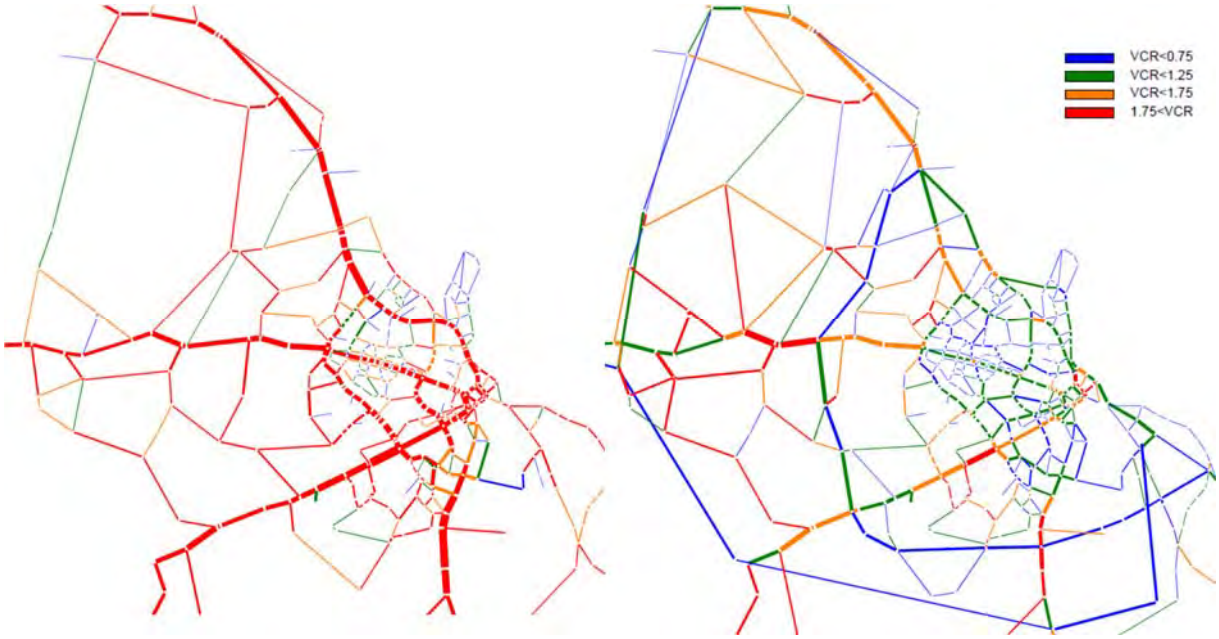
Purpose	Without Urban Structure Plan	Master Plan Case	diff.
To Work	15.4	13.6	-1.8
To School	6.3	5.1	-1.2
Business	18.4	16.6	-1.9
Private	17.9	15.9	-1.9
To Home	12.2	10.6	-1.7
All	12.6	11.0	-1.6

Source: JST

b) Effect of Road Development

Figure 8.2.22 shows comparison of road traffic congestion situation in 2040 between Do-nothing Case and Alternative Case. Alternative Case includes Road development and Urban Structure Plan development based on Do-nothing Case. In other words, compared with Do-nothing Case, the Alternative Case shows the effect of urban structure strategy and road development. From the road traffic viewpoint, congestion will be improved drastically with the development.

Table 8.2.17 shows comparison of the traffic volume and travel time. Average congestion ratio in whole road network will be improved from 1.97 to 0.76. Although traffic volume increases, total travel time will be reduced by 59%. Based on not only these values but also public transit users' effect and the benefit of urban strategy development, the benefit of road development is roughly estimated to be 1.5 billion US dollars per year.



<Do-nothing Case> **<Alternative Case>**

Source: JST

Figure 8.2.22 Comparison of Road Congestion between Do-nothing and Alternative Case

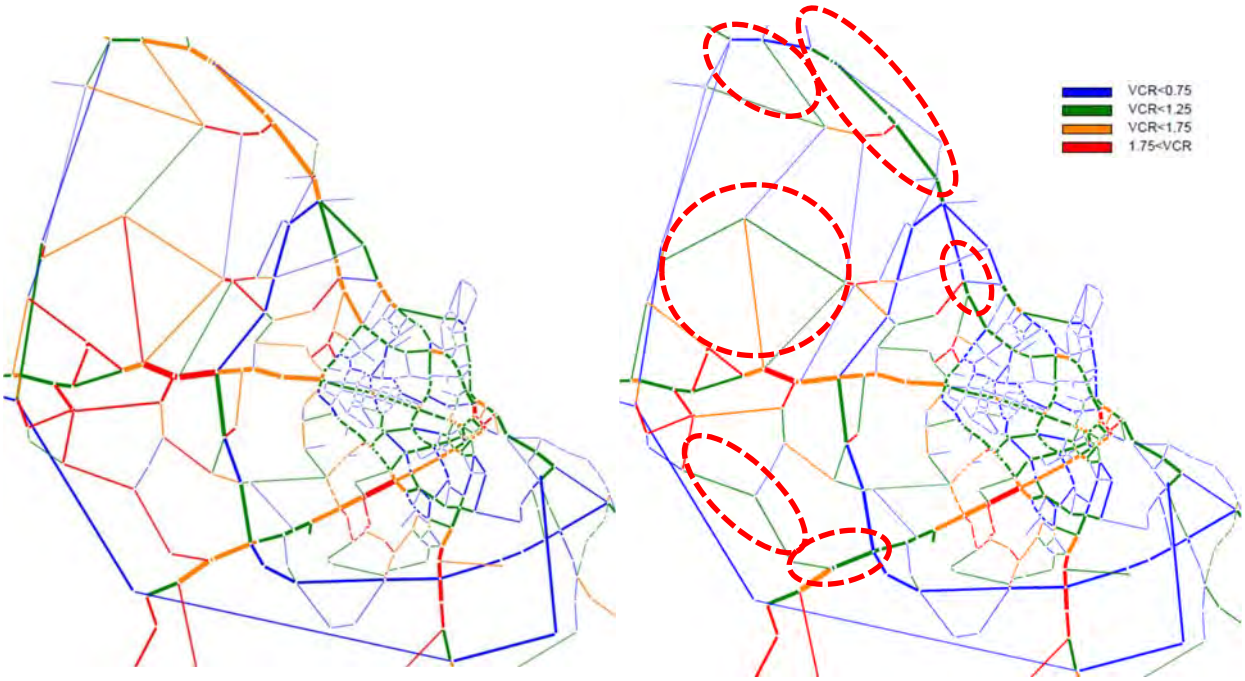
Table 8.2.17 Comparison of Traffic Volume and Time of Do-nothing Case and Alternative Case

Item	2040 Do nothing Case	2040 Alternative Case	Difference
Total vehicle kilometer (veh km)	19,471,942	20,944,250	8% up
Total vehicle time (veh･hour)	1,811,605	734,934	59% down
Average Congestion Ratio	1.97	0.76	61% down

Source: JST

c) Effect of Rail Development

Figure 8.2.23 shows comparison of road traffic congestion situation in 2040 between Alternative Case and Master Plan. Alternative Case doesn't include Rail development from Master Plan Case. Therefore, comparison between them shows the effect of rail development. On several portions of road network, congestion will improve. Table 8.2.18 shows comparison of the traffic volume and travel time. Average congestion ratio in whole road network will be improved from 0.76 to 0.61. Traffic volume and total travel time will be reduced by 19% and 26% respectively. It should be noted that the result shown here is about road traffic situation. It means that not only rail passengers, but also private vehicle drivers get the benefit of rail development. Based on not only these values but also public transit users' effect, the benefit of rail development is roughly estimated to be two billion US dollars per year.



<Alternative Case> **<Master Plan Case>**

Source: JST

Figure 8.2.23 Comparison of Road Congestion between Alternative Case and Master Plan Case

Table 8.2.18 Comparison of Traffic Volume and time of Alternative Case and Master Plan Case

Item	2040 Alternative Case	2040 Master Plan Case	Difference
Total vehicle kilometer (veh km)	20,944,250	16,866,595	19% down
Total vehicle time (veh･hour)	734,934	545,036	26% down
Average Congestion Ratio	0.76	0.61	15% down

Source: JST

*Note: Description of the Data for Road traffic assignment and Public transit assignment are mentioned in the Annex. Data for the Transport Demand Forecast is stored in the attached CD-R.

CHAPTER 9 STRATEGIC ENVIRONMENTAL ASSESSMENT

9.1 Outline of Environmental Assessment System in Tanzania

This section summarizes the outline of environmental assessment system in Tanzania, including Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA).

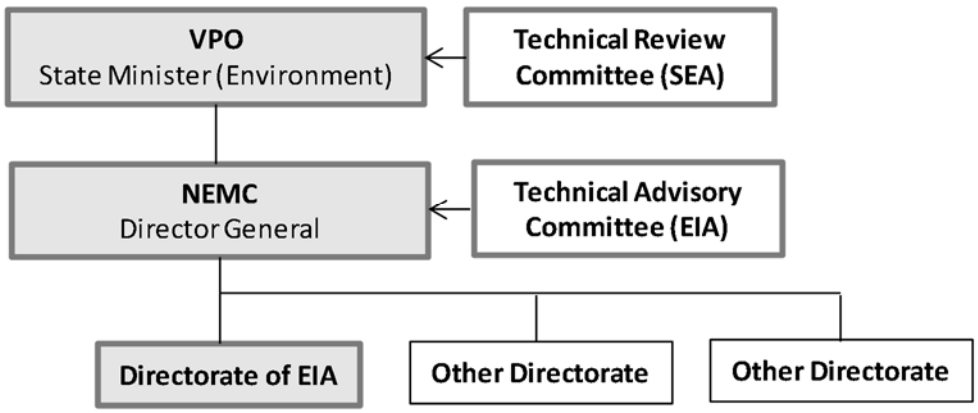
9.1.1 Institutional Structure

The roles and responsibilities of organizations related to the environment are summarized in Section 2.3.5 in this report.

Figure 9.1.1 below shows the relationship between the environmental management-related institutions in Tanzania. As described in the Section 2.3.5, the Minister of State Responsible for Environment under VPO has the overall responsibility for matters relating to the environment. The Minister shall make decisions on the approval of the Environmental Impact Statement for EIA and Final SEA Report, and shall issue EIA certificate and SEA approval notice.

In terms of section 87 (2) of Environmental Management Act (EMA), 2004, NEMC may set up a cross-sectoral Technical Advisory Committee to participate in reviews of Environmental Impact Statement. Likewise, VPO may call upon a Technical Review Committee for review of SEA report.

The details of EIA and SEA procedure are described in the following Sections 9.1.3 and 9.1.4.



Source: JST

Figure 9.1.1 Institutional Structure for Environmental Management

9.1.2 Policy and Legal Framework

The key policy and legal framework for environmental assessment are summarized in this section.

(1) National Environmental Action Plan (NEAP)

The Ministry of Tourism, Natural Resources and Environment took the first step towards incorporating environmental concerns into national planning and development with the publication of NEAP in 1994. NEAP identified the following six major national issues in need of urgent attention:

- Land degradation;
- Access to good quality water;
- Pollution;
- Loss of wildlife habitats and biodiversity;

- Deterioration of marine and freshwater systems; and
- Deforestation.

NEAP established the foundation for the National Environmental Policy to be formulated.

(2) National Environmental Policy

The National Environmental Policy, adopted in 1997, seeks to provide the framework for making the fundamental changes required in order to incorporate environmental considerations into the mainstream of decision-making. It provides guidance and planning strategies to determine how actions should be prioritised, and requires the monitoring and regular review of policies, plans, and programs. It further provides for sectoral and cross-sectoral policy analysis, so that compatibility among sectors and interest groups can be achieved and the synergies between them exploited.

(3) Environmental Management Act 2004

The EMA 2004 specifies measures for protecting ecological processes, the sustainable utilization of ecosystems, and environmental protection. It seeks to legalize current environmental policy and harmonise the legislation. The specific interests of EIA/SEA practitioners are Part VI: Environmental Impact Assessment, Part VII: Strategic Environmental Assessment, and Part XIV: Public participation in environmental decision-making.

The EMA 2004 sets out general principals, the foremost of which is that every person living in Tanzania shall have a right to clean, safe and healthy environment (Section 4 (1)).

(4) EIA and Audit Regulations 2005

The EIA and Audit Regulations set out in detail the process to be followed in conducting an EIA, the form and content of EIAs, the review process, decision-making processes and appeals. The EIA steps are described in more detail in section 9.1.3 of this chapter.

(5) SEA Regulations 2008

The regulations shall apply to all bills, regulations, national policies, strategies, programmes and plan undertakings unless exempted by the Minister. The regulations set out general requirements, the process to be followed in conducting a SEA, content of SEA report, the review process, and monitoring process. The SEA steps are described in more detail in section 9.1.4 of this chapter.

9.1.3 EIA Procedure

The steps required to conduct an EIA are outlined in the following subsections.

(1) Registration

An application for an EIA certificate shall be made in the format of a project brief set out in the Third Schedule of the Environmental Impact Assessment and Audit Regulations, 2005. A project brief shall be prepared by EIA experts or firms of experts registered by NEMC. The Environmental Management (Fee and Charges) (Amendment) Regulations, 2016 mention prescribed fees to accompany the applications in EIA process, i.e. the fee for application for EIA is TSH 50,000 and for submission of project brief is TSH 150,000. They are generally paid at once during registration. Proponents are requested to contact NEMC for the latest information on the fees for each step.

(2) Screening

The screening process shall be undertaken with the objective of determining whether an environmental impact assessment has been undertaken. It will lead to one of the following decisions:

- Type A projects: An EIA is required where the project is known to have significant adverse environmental impacts
- Type B projects: A preliminary environmental assessment is required where more information is needed to make a more informed screening decision
- An EIA is not necessary where the project is unlikely to cause significant environmental impacts.

On determination of the project brief, the decision of NEMC together with the reasons thereof, shall be communicated to the proponent within 45 days from the date of submission of the project brief.

(3) Scoping and Terms of Reference

Scoping is an early and open process for determining the scope of issues related to the proposed action. An EIA shall be conducted in accordance with scoping and the terms of reference (TOR) developed during the scoping exercise by the proponent. A scoping report and TOR shall be submitted to NEMC for review and approval before the commencement of the EIA study. TOR will be approved by NEMC within 14 days of submission.

(4) Environmental Assessment and Submission of Environmental Impact Statement (EIS)

An EIA study shall be conducted according to the approved TOR and adhere to the Environmental Management Act 2004 and the EIA and Audit Regulations 2005.

The objective of EIA study is:

- to identify the anticipated environmental impacts of the project and the scale of the impacts;
- to identify and analyse alternatives to the proposed project;
- to propose mitigation measures to be taken during and after implementation of the project; and
- to develop an environmental management plan with mechanisms for monitoring and evaluating the compliance and environmental performance which shall include the cost of mitigation measures and the timeframe of implementing the measures.

During the process of conducting an EIA study, the proponent shall, in consultation with NEMC, seek the views of any person who is or is likely to be affected by the project. Both the oral and written comments and minutes of the meeting during public consultation shall be attached as an annex to EIS.

(5) Review of Environmental Impact Statement (EIS)

NEMC has 60 days to carry out the review of EIS, which includes some mandatory and discretionary activities.

In conducting the review, NEMC may:

- set up a cross-sectoral Technical Advisory Committee (TAC) to assist with the review process;
- request the proponent to supply additional information;
- conduct on-site visits for purposes of inspecting the project or undertaking which is the

subject of review at the proponent's cost; and
- hold public hearings.

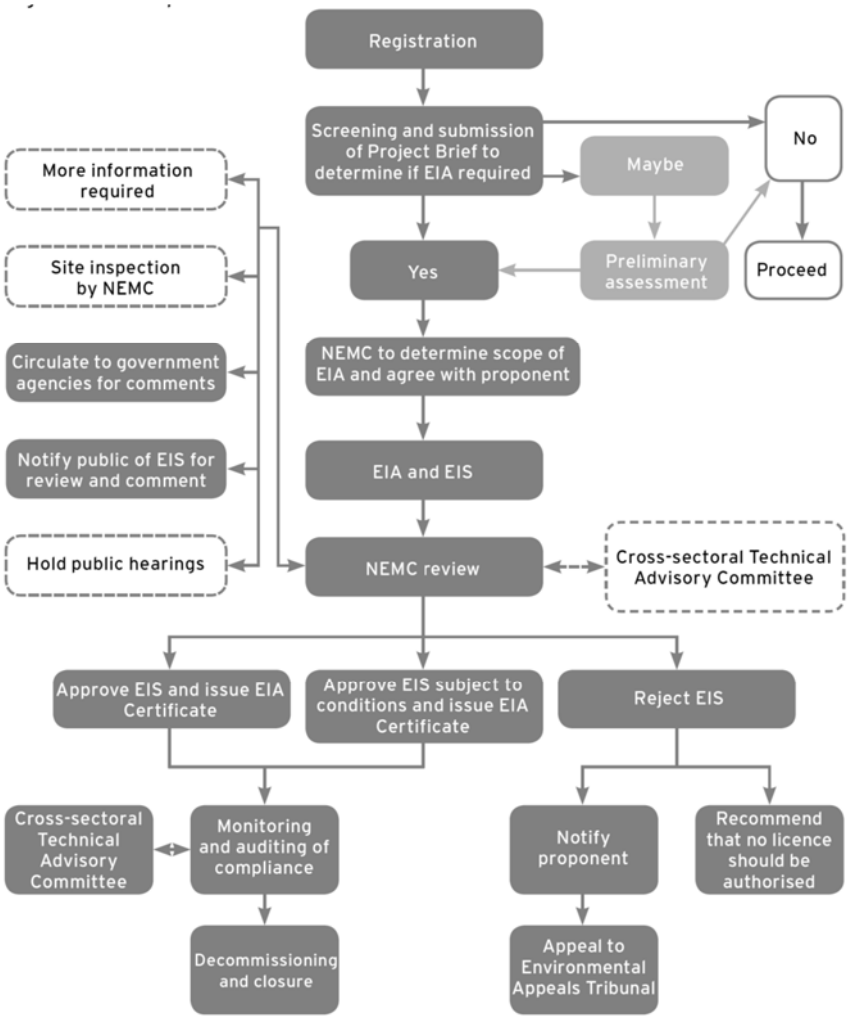
Upon completion of the review process, the Council shall prepare a report on the review of EIS and submit it to the Minister.

(6) Approval of Environmental Impact Statement (EIS)

The Minister shall take into account the review process and make a decision that:

- the EIS is approved;
- the EIS is not approved; or
- the EIS is approved but is subject to specified conditions.

Where the Minister approves an EIS, an EIS certificate shall be issued.



Source: SADC Environmental Legislation Handbook 2012

Figure 9.1.2 EIA Procedure

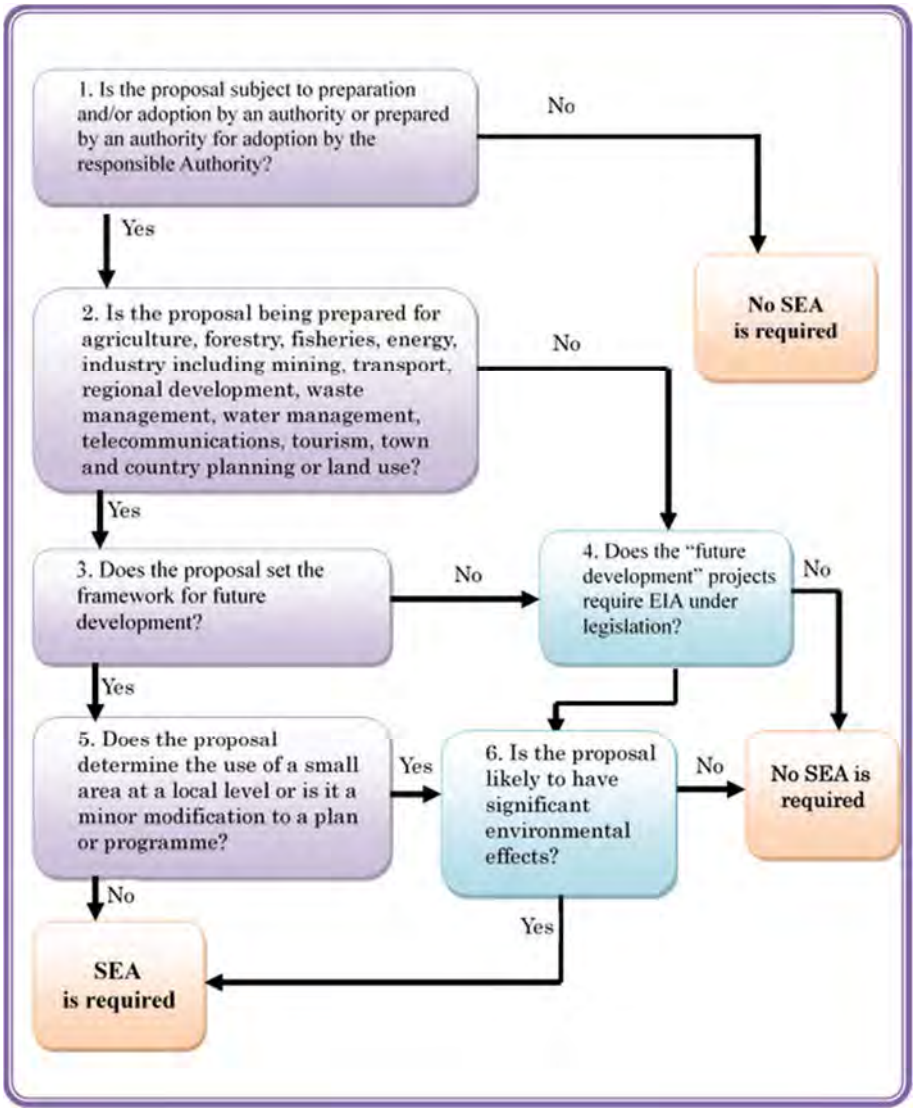
9.1.4 SEA Procedure

The steps required to conduct a SEA are summarized in this sub-section based on the SEA Regulations, 2008 and the National Guidelines for SEA (Draft), 2016. While the EIA exercises are required to be conducted only by experts or firms of experts registered by NEMC (Section 83 of the EMA, 2004), there is no such provision for SEA exercises.

(1) Screening

This step determines if there are important environmental effects of a policy, bill, regulation, strategy, plan or programme. The main tasks carried out in this step are:

a) The responsible authority prepares a summary of views as to whether or not the proposal is likely to have significant environmental effects.
b) The responsible authority submits the summary to the Director of Environment and other relevant Ministries for consideration.
c) Sector Ministries and other stakeholders provide views and comments on the summary within 21 days of receipt of the summary.
d) The Director of Environment consolidates and analyses views of stakeholders for decision within 14 days.
e) The Director of Environment/the Minister responsible for Environment determines whether SEA is required or not and communicate the decision to the responsible authority within 14 days.



Source: National Guidelines for Strategic Environmental Assessment (Draft)

Figure 9.1.3 Logical Framework for Screening

(2) Scoping and Terms of Reference

A scoping process shall be conducted to determine the scope of the assessment and focus of the SEA,

to identify the main stakeholders, to prevent the production of unnecessary data to ensure an efficient process, and to provide formal guidance on the range of issues that must be addressed in SEA process.

a) The responsible authority determines and establishes level of details of the information to be included in SEA report, key authorities to be consulted, opportunities for public consultation, and the consultation period it intends to use.

b) The responsible authority develops Terms of Reference.

c) The responsible authority prepares and submits scoping report to the Director of Environment.

d) The Director of Environment approves the scope and TOR of SEA within 14 days of submission.

(3) Preparation of Draft SEA Report

The responsible authority shall identify and assess likely impacts and alternatives, and prepare a Draft SEA Report. The report shall include such information as specified in the Third Schedule of the Regulations as may be required, taking account of:

- the current knowledge and methods of assessment of environmental matters;
- the contents of, and level of detail in, the bill, regulations, strategy, plan or programme;
- the stage of the bill, regulations, strategy, plan or programme in the decision-making process;
- the extent to which any matters to which the report relates would be more appropriately assessed at different levels in that process in order to avoid duplication of the assessment; and
- the public interest involved.

Table 9.1.1 Contents of SEA Report

1.	An outline of the contents and main objectives of the plan or programme, and of its relationship with other relevant bill, regulations, policy, strategy, plans, and programmes.
2.	The relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the bill, regulations, policy, strategy, plan or programme.
3.	The environmental characteristics of areas likely to be significantly affected.
4.	Any existing environmental problems which are relevant to the Bill, regulations, policy, strategy, plan or programme.
5.	The environmental protection objectives, established at national level, which are relevant to the Bill, regulations, policy, strategy, plan or programme and the way those objectives and any environmental considerations have been taken into account during its preparation.
6.	The likely significant effects on the environment, including short, medium and long-term effects, magnitude and extent of impact, likelihood of occurrence, reversibility, permanent and temporary effects, positive and negative effects, and secondary, cumulative and synergistic effects, on issues such as (a) biodiversity, (b) population, (c) social, (d) human health, (e) fauna, (f) flora (g) soil, (h) water, (i) air, (j) climatic factors, (k) material assets, (l) cultural heritage, including architectural and archaeological heritage, (m) landscape, and (n) the inter-relationship between the issues referred to in sub-paragraphs (a) to (l).
7.	The measures envisaged to prevent, reduce and as fully as possible offset any significant adverse effects on the environment of implementing the Bill, regulations, policy, strategy, plan, or programme.
8.	An outline of the reasons for the selecting the alternatives dealt with, and a description of how the assessment was undertaken including any difficulties (such as technical deficiencies or lack of know-how) encountered in compiling the required information.
9.	A description of the variables and measures envisaged for monitoring.
10.	A non-technical summary of the information provided under paragraphs 1 to 9.
11.	Comprehensive Swahili version of the non-technical summary.

Source: Third Schedule, The Strategic Environmental Assessment Regulations, 2008

(4) Consultation and Participation

Public consultation is mandatory when undertaking SEA. The responsible authority will have to identify the best means to ensure that stakeholders can participate effectively, and that their

viewpoints are given proper consideration. As stakeholders are comprised of many interest groups with conflicting objectives, the role of the public consultation in SEA should not be to suppress differing views but to provide a mechanism for identifying and trying to solve the conflict in a constructive way.

Authorities which are likely to be concerned by the effects of implementing policy, bill, regulations, strategy, plan or programme must be given an early and effective opportunity to express their opinions.

The results of these consultations must be documented in the SEA report.

1) The responsible authority consults stakeholders to obtain their views and comments on the Draft SEA Report.

2) The responsible authority prepares Final Draft SEA Report and submits to the Director of Environment for review.

(5) Revision of Draft SEA Report

The Director of Environment will arrange the site verification visit and Technical Review Committee (TRC) meeting under the financing from the responsible authority as described below.

a) The Director of Environment may engage a team of experts for site verification visits where necessary, which may take 30 days.

b) The Director of Environment engages TRC, which is a cross-sectoral technical committee composed of members from sectors related to environment and resource management, in reviewing the Final Draft Report.

c) The Director of Environment collates the TRC's comments and recommendations of the site visit report and submits the review report to the responsible authority within 14 days for finalisation of SEA report.

d) The responsible authority shall prepare and re-submit a revised Final SEA Report which has included comments and recommendations from all stakeholders and TRC to the Minister responsible for Environment for approval considerations.

(6) Approval of SEA Report

The Minister responsible for Environment shall make the decision within 21 days that:

- the SEA Report is approved;
- the SEA Report is not approved; or
- the SEA Report is approved but is subject to the relevant authority incorporating recommended changes.

When the Minister has approved the SEA Report, he/she shall notify the responsible authority in writing and issue a SEA approval notice.

(7) Monitoring

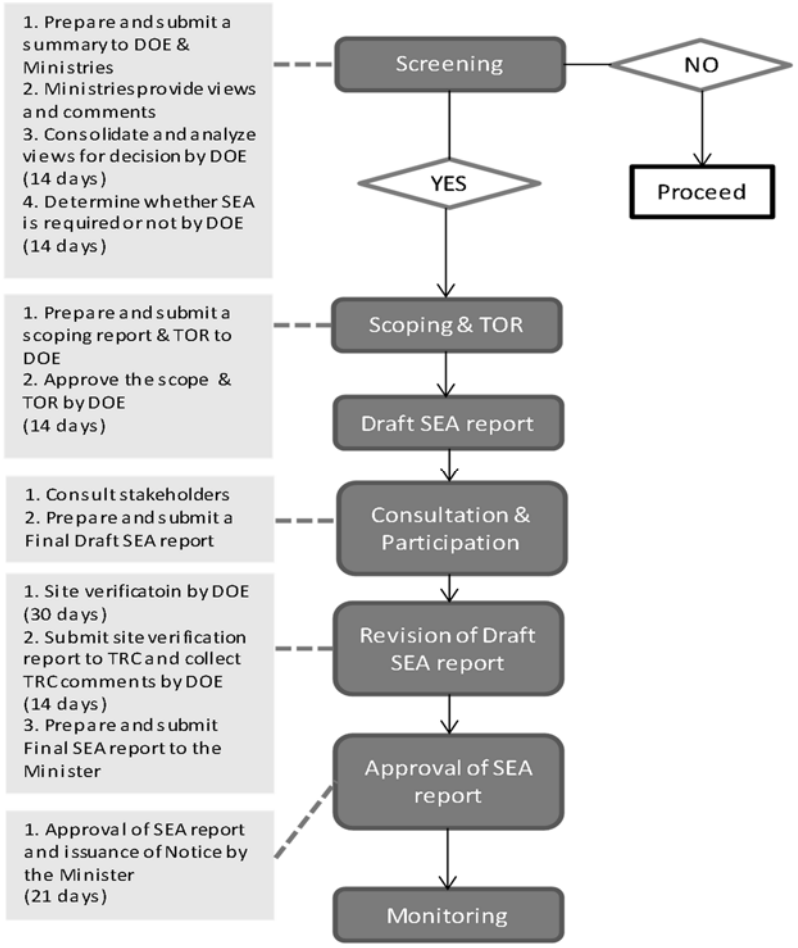
The responsible authority shall monitor the significant environmental effects of the implementation of every bill, regulation, policy, strategy, plan or programme for which it has carried out a SEA in a manner which enables it to:

- identify any unforeseen adverse effects at an early stage; and
- undertake appropriate remedial measures.

The responsible authority is further required to submit periodic reports to the Director of Environment

on the implementation of such policy, bills, regulations, strategies, plans or programmes.

Figure 9.1.4 shows the overall procedure of SEA in Tanzania.



Source: JST

Figure 9.1.4 SEA Procedure

9.2 Description of Revision of Urban Transport Master Plan

9.2.1 Background

The current M/P with the target year of 2030 was formulated in 2008 with the support from JICA. Some of the projects proposed in the current M/P have been launched. This includes Tazara junction fly-over construction, New Bagamoyo Road widening, Nelson Mandela Road widening, introduction of BRT, and Mwalimu Nyerere Bridge (Kigamboni Bridge) construction. However, rapid population growth as well as increase in the number of vehicle registration has been overwhelming the forecast of the current M/P. The government is striving to tackle the growing traffic demand and has commenced trial operation of railway, which was not planned in the current M/P. Considering the current urban transport issues and rapidly changing conditions in Dar es Salaam, it is required to revise and update the current M/P.

9.2.2 Outputs

The expected outputs of the study are:

(1) Revised urban transport M/P in Dar es Salaam, for which the target year is set to be the year of 2040, and

(2) Technical Transfer to formulate/revise urban transport M/P.

9.2.3 Environment Impact Factor of the M/P

The following factors were determined as environment impact factors which may affect the environment and society in view of urban transport system and land use when the revised M/P is realised.

- Urban transport system
  - Construction, widening and improvement of roads
  - Introduction of new public transport system
  - Land acquisition for roads, etc.
  - Traffic volume change
- Land use
  - Land use alteration
  - Protection of reserved area

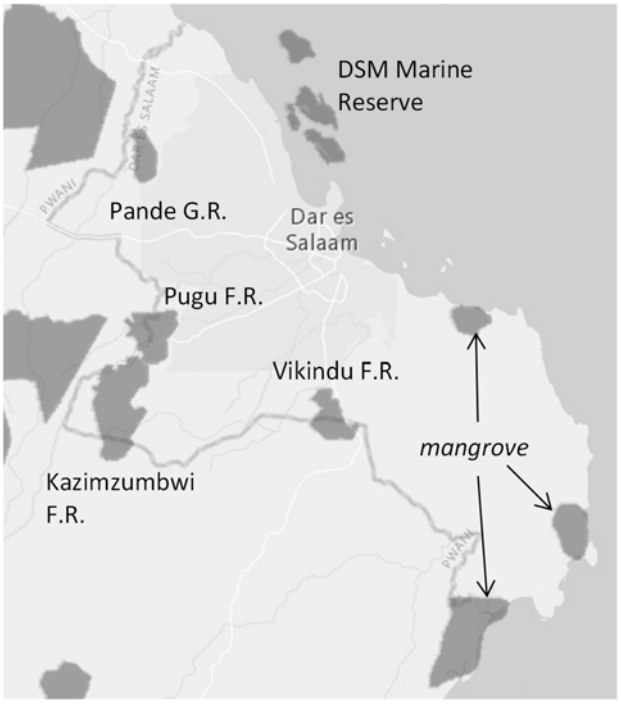
9.3 Key Baseline Information and Issues of Concern

The city's growing population and rapid urbanisation represent the most dynamic factors underlying most of the immediate causes of degradation of natural environment. It is estimated that about 70% of the population live in over 40 unplanned communities covering an area of 10,000 ha. With the population projected to grow by tens of millions of people in coming decades, some anticipate far more informal housing. Human activities such as illegal logging, often aiming at making charcoal, also contributes to the destruction of the natural rainforest, leading to deforestation and soil erosion. The following section describes some key baseline information and issues of concern.

(1) Forest and Protected Areas

Dar es Salaam contains approximately 2,500 ha of protected forest reserves including Pande Game Reserve, Dondwe Coastal Forests, and Pugu Forest. Pande Game Reserve and Dondwe Coastal Forests is recognized as one of the endangered Important Bird Area by Birdlife International. The site comprises two small forested areas on the outskirts of DSM, Pande Game Reserve (1,226 ha) to the north-west of the City and Dondwe forest (area unknown) to the south. There are four distinct tree species with the remaining forest surrounded by fire-maintained grassland and secondary scrub in Pande Game Reserve. Dondwe forest is rather ill-defined and is not mapped. Pugu Forest Reserve, a rainforest extending into DSM is the source of the Msimbazi River. Due to urban expansion and encroachment from nearby communities, Pugu forest experienced 23% decline in forest coverage from 1995 to 2010 and contains less than 400 ha in reasonable condition.

There are over 2,266ha of mangrove forests distributed throughout the coastal area. They serve as a natural defence, a nursery for many species and provide a physical habitat for numerous fish, crustaceans, and many varieties of important species, but they are a threatened resource due to unregulated use. They are cut and used by local people for construction, export, firewood, charcoal making, boat building, salt making and farming rice. Indirect impacts of environmental degradation include reduction in tourism, fisheries, recreation, and other ecological and productivity impacts.



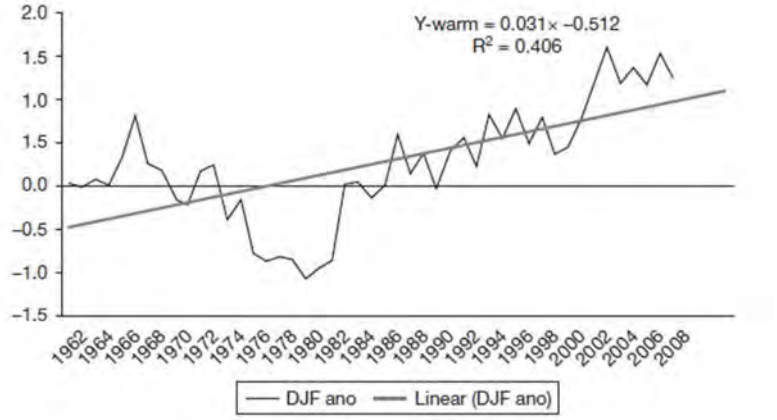
Note: F.R. and G.R. mean Forest Reserve and Gamer Reserve respectively.
Source: IUCN Red List

Figure 9.3.1 Forest Reserve and Other Protected Area in DSM

(2) Weather, Climate Change and Disaster Risk

The climate of DSM is greatly influenced by the northeast monsoon which prevails from the months of March to October and the southeast monsoon between October and March. It is also greatly influenced by the sea due to its proximity to the Indian Ocean. This makes the city and other coastal towns in the country experience relatively high air temperature and humidity throughout almost the whole year. Air humidity in DSM ranges between 67% and 96% in a year, with April being the most humid month. The annual rainfall is about 1,100mm and it usually peaks in April and December. This signifies the two rainy seasons: the long rain season from mid-March to May with an average of 150-300mm per month and the short rain season from November to January with an average of 75-100mm per month.

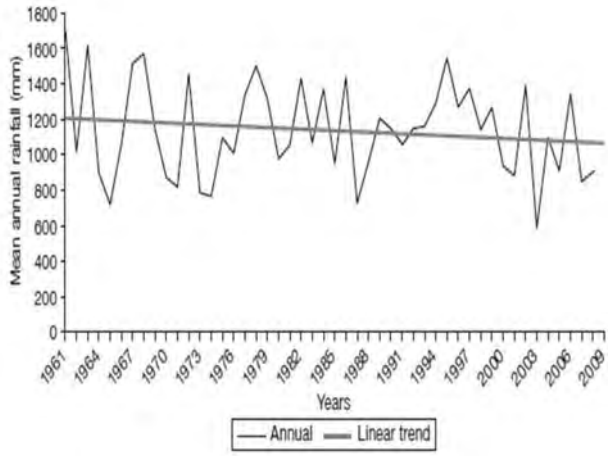
Increasing temperature trends are detectable in a number of temperature indices. Figure 9.3.2 below shows the trend of mean maximum temperature anomalies during warmest months (December to February) for the period of 1962 – 2008.

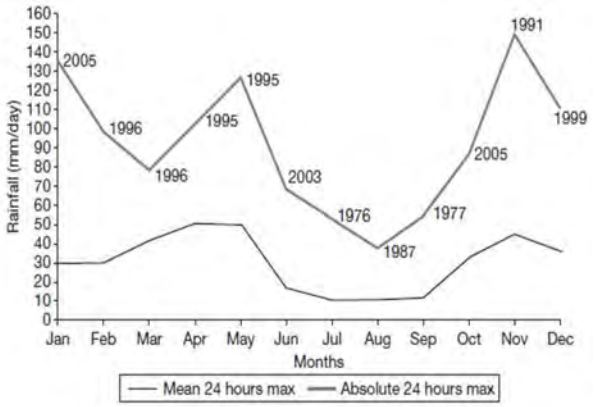


Source: WB (2011) Climate change, disaster risk, and the urban poor

Figure 9.3.2 Trends in Mean Maximum Temperature Anomalies during Dec - Feb

Figure 9.3.3 and Figure 9.3.4 below shows the historical trend in mean annual rainfall, and mean and absolute 24 hours maximum rainfall during 1971 - 2009 in DSM. There were significant detectable trends in total rainfall decline over the past five decades. The absolute 24 hours maximum rainfall during the rainy seasons was recorded within the past few decades.





Source: WB (2011) Climate change, disaster risk, and the urban poor

Figure 9.3.3 Trend in Mean Annual Rainfall in DSM

Figure 9.3.4 Mean and Absolute 24 Hours Max Rainfall

While it is not clear whether overall rainfall in Tanzania will increase or decrease as climate change proceeds, an important projected aspect of climate change is an increase in climatic variability, which would result in more frequent severe floods and droughts in the city. Heavy rainfall often causes flooding in DSM, particularly in low-lying and flood-prone informal settlement areas where the city's poor reside.

Areas prone to floods include: Msasani Bonde la Mpunga (about 60 ha of mixed residential, commercial and institutional settlements and one of the fastest growing settlements in Kinondoni); Msimbazi valley; Jangwani (a slum area characterized by annual flooding during rainy season); Mikocheni (challenged by storm water drainage); and the city centre (exacerbated by poor infiltration and outdated non-functioning storm water drainage system).

Msasani Bonde la Mpunga:

This area has a great role in drainage system, in which two main storm water channels exist. The Master Plan of 1979 declared this area as hazardous land. The area has experienced fast development due to its proximity to the new American Embassy, a referral private hospital, big shopping malls, and residence of former senior government officials.

Msimbazi Valley:

The area floods frequently and continues to be populated, exposing residents to life-threatening floods and health problems related to floods. The influx of people has been accelerated by a number of factors such as easy access to unregulated farming and building plots, its proximity to the city centre, low level of education and low-cost housing.

Jangwani:

This is a slum area found on the left side of Morogoro Road on the way to city centre from Magomeni. It is a low-lying area which is characterized by floods during rainy season. The dwellers at the mouth of the river are at high risk with the Msimbazi River passing through the valley. The area was declared as not a residential area by the former minister for Lands and Human Settlement Development due to its susceptibility to environmental threats.

City Centre and Mikocheni Area:

This is the most flooded area in the city. The problem is exacerbated by poor infiltration and outdated and un-functioning storm water drainage system. In Mikocheni, the problem of flooding has been exacerbated by diversion of natural storm water drainage channel.

(3) Marine and Coastal Resources

The coastal zone of DSM is comprised of a complex mixture of beautiful sandy beaches, rocky beaches, as well as rocky cliffs and platforms, islands fringed by coral reefs, numerous coral patch reefs, estuaries streamlined with mangrove forests, and lagoons with sea grass beds covering large areas. About eight mangrove species can be found along the beach areas of the city namely Rhizophora *mucronata* (‘Mkoko’ in Kiswahili), Sonneratia *alba* (‘Mlilana’ or ‘Mpira’), Avicennia *marina* (‘Mchu’), Ceriops *tagal* (‘Mkandaa’), Bruguiera *gymnorrhiza* (‘Msinzi’ or ‘mshinzi’), Heritiera *littoralis* (‘Msikundazi or Mkungu’), Lumnitzera *racemosa* (‘Kikandaa’ or ‘Mkandaa dume’) and Xylocarpus *granatum* (Mkomafi’).

The city has about 88 species of hard coral species belonging to 34 genera. There are about 12 species of seagrasses in the coastal waters occupying much of the shallow lagoon between the islands and the mainland along the entire coast. The city coast is home to a number of endangered species such as marine turtles, Hawksbill (Eretmochely imbricata) and Green Turtle (Chelonia mydas), dolphins, Humpback whales and whale sharks. Fishing is one of the major economic activities along the coastal areas and is mainly done for both subsistence and commercial purposes. Fishes of commercial importance to local communities include Siganidae, Lutjanidae, Lethrinidae, Scaridae, Labridae, Acanthuridae, Mullidae, Haemulidae, Serranidae, and Dasyatidae. Kindondoni Municipal Council has one standard fish market at Kunduchi area and many other non-official markets near the sea.

(4) Air Pollution

There is high level of generation of carbon dioxide and carbon monoxide due to severe road traffic congestion of trunk roads in urban areas during peak hours and spending more time on the road. Several studies have been performed since 1991 and the latest one was conducted by Othman in 2010.

Table 9.3.1 shows the road side air quality in terms of SO_2, NO_2, CO and dust (SPM) in Dar es Salaam from several studies.

Table 9.3.1 Air Pollutant Levels in DSM

Site	NO2(μg/m^{-3})	SO2(μg/m^{-3})	SPM(μg/m^{-3})	CO (μg/m^{-3})	Reference
Askari monument	-	3968	----		Mwakibete (1991)
	250	3290	187	-----	NEMC (1992)
	298	872	141	-----	Othman (1996)
	43.7				Henricson (1999)
	44.8			7.4	Musabila et al. (2003)
	1000	9867	762	9.7	Othman (2010)
Gerezani	5110	1687	----	-----	Othman (1991)
	428	3356	692	-----	NEMC (1992)
	497	1886	723	----	Othman (1996)
	59.8			9.6	Musabila et al. (2003)
	567	9833	1175	15.3	Othman (2010)
Kariakoo	249	3323	757		NEMC (1992)
	288	1520	782	----	Othman (1996)
	733	10533	1134	18.0	Othman (2010)
MMC	200	3319	609		NEMC (1992)
	290	1662	136		Othman (1996)
	42	4757	187	1.8	Othman (2010)
Kunduchi Beach Hotel	187	1230	85	----	NEMC (1992)
	75	309	78	----	Othman (1996)
	20	235	77	0	Othman (2010)
Several Sites	<53	<1385	<1161	------	Jackson (2005)
WHO Guide Value	200	350	230	10	

Source: Othman (2010) modified by JST

9.4 Alternative Plans

The consideration and development of alternatives is at the heart of SEA and a meaningful way to address environmental and social issues while informing and influencing decision-making processes. In this SEA, alternatives were developed from three dimensions namely urban structure, road network, and public transport using expert judgement, taking into account the existing policies, legal and institutional frameworks, the existing baseline characteristics, stakeholders' views, and local knowledge and information.

As discussed in Chapter 7, there are three urban structure alternatives including trend or do-nothing case. The trend case is the case that all the urban functions concentrates on CBD area and urban sprawl will continue to suburbs.

In the case of satellite city development, several satellite cities which have residential and business functions will be developed. The proposed locations for satellite cities are Bunju, Luguruni, Pugu, Kongowe, and Kibada. In Tegeta and Kimara, relatively smaller satellite cities are proposed to be developed.

The major difference between the case of satellite city development and the case of balanced structure with satellite cities and sub-centres is the development of sub-centres which partially absorb business functions from CBD. The number of trips between the satellite cities and CBD will be reduced by developing sub-centres. There will be a semi-circular road connecting the proposed inner satellite cities such as Tegeta, Kimara, Ukonga, Mbagala, and Kibada, which enhances not only traffic and logistic flow but also redundancy of the city's road network.

The case of balanced structure with satellite cities and sub-centres is recommended as the most suitable option and adopted for further examination.

Road network has also three scenarios: do nothing case, arterial road network development case, and missing link completion case.

The do-nothing case only entails on-going projects such as road expansion and construction of flyovers. The case of arterial road network development includes new Selander Bridge, DSM outer ring road, DSM-Chalinze expressway, and Kigamboni Road development. The case of missing link completion proposes middle ring road and modified outer ring road to connect missing link. Based on the recommended urban structure, the last case, missing link completion, is selected for further discussion as the last case fits better with the proposed DSM urban structure and related functions.

In public transport network plan, four alternatives were considered. Unlike the urban structure alternatives and road network plan, do-nothing case covers only on-going projects, that is BRT phase 1-4 and SGR from DSM to Morogoro. The BRT incentive case is the case to develop BRT on middle ring road route and Kigamboni route and to extend the service on Morogoro Road and Bagamoyo Road as well as completion of BRT up to phase 6. There are two railway incentive cases: the first case is to adopt TRC's plan for railway development and to develop BRT on Kigamboni route as well as completion of BRT up to phase 6 (see 3.2.3 Public Transport Development Plan in Chapter 3), and the latter case is to develop circular MRT around the CBD and MRT on Bagamoyo Road and Morogoro Road, and to develop BRT on middle ring road route and Kigamboni route as well as completion of BRT up to phase 6.

Table 9.4.1 Alternative Plans

Case	Case Name	Urban Structure	Road Network	Public Transport
Case 0	Do Nothing	Trend	Existing network	BRT: Phase 1-4 Rail: Existing + on-going project
Case 1	BRT Incentive	Balanced Structure with Satellite Cities & Sub-centres	Existing network + All road projects	BRT: Phase 1-6 + Kigamboni line Rail: Existing + on-going project
Case 2	Railway Incentive-1 (TRC's plan)			BRT: Phase 1-6 + Kigamboni line Rail: TRC's FS route
Case 3	Railway Incentive-2 (Master Plan)			BRT: Phase 1-6 + Kigamboni line Rail: MRT (Loop, Bagamoyo, and Morogoro line)

Source: JST

9.5 Objective and Approach of SEA

The Environmental Management Act of 2004 and its regulations of 2008 govern SEAs in Tanzania. Part II Section 4 of the Strategic Environmental Assessment Regulation, 2008 mentions the following key objectives of undertaking SEA:

(1) Ensure that environmental concerns are thoroughly taken in draft bills, regulations, plans, strategies or programs.

(2) Enable the public to contribute to the consideration of environmental concerns in the preparation of bills, regulations, plans, strategies or programs.

(3) Establish clear, transparent and effective procedures for formulation of bills, regulations, plans, strategies or programs and

(4) Integrate environmental concerns into measures and instruments designed to further sustainable development.

This SEA is undertaken in order to inform the planning process and to mainstream environmental considerations into the urban transport master plan. The overall objective is to ensure that social, economic and biological/ecological considerations are fully integrated into the proposed urban transport master plan for DSM. Given the potential trade-offs between competing development goals and the possible need for compromise in reconciling them, it is proposed to draw "limits of acceptable use/change" principles to reinforce the SEA as a framework for long-term environmental and social management.

9.6 Scoping

9.6.1 Objective of Scoping

Scoping exercise is the second key step in a series of steps that are followed in SEA process in Tanzania. The objectives of the scoping exercise are provided in chapter 3 subsection 3.2.2 of the draft SEA Guidelines of 2016 and adopted to suit this scoping and the SEA as follows:

(1) To provide a wide range of consultees information at the early stage in the SEA process;
(2) To identify the main stakeholders that will be negatively or positively impacted by the proposed plan;
(3) To provide an opportunity for interested and affected stakeholders in proposed plan for the purpose of exchanging information and express their views and concerns regarding the proposal before SEA is undertaken;
(4) To identify key issues and concerns associated with the proposed plan;
(5) To focus the study on reasonable alternatives and relevant issues to ensure that the resulting assessment is useful to the decision-maker and address the concerns of interested and affected communities;
(6) To facilitate an efficient assessment process that saves time and resources and reduces costly delays, which could otherwise arise where consultation had not taken place; and
(7) To determine and establish the terms of reference and level of details of the information to be included in the SEA report (boundaries of the SEA process).

In addition to the above objectives, this Scoping also covers the following objectives:

(1) To explore and suggest appropriate trade-offs between competing development goals and the possible need for compromise in reconciling them by drawing on "limits of acceptable use/change" principles to reinforce the SEA as a framework for long-term sustainability;
(2) To facilitate sustainability appraisal by evaluating economic, political, social, institutional, cultural and environmental parameters and presenting its findings in a way that will facilitate an informed and integrated decision that will foster sustainable development.

9.6.2 Scoping Matrix

Since comparative examination of alternatives is the heart of SEA, the object of scoping is all the alternative plans. The result of scoping is summarized below in the form of a matrix.

Table 9.6.1 Scoping Matrix

Item	Rating		Impact predicted and Reason of the rating (A to D)
	Co	Op	
Pollution control / Public Nuisances			
Air pollution	B-	B+/-	**Co:** The amount of pollution due to air emissions is expected to increase temporarily due to increased movement of construction equipment. **Op:** The quantity of automobile emission in some parts of the city is expected to decrease due to alleviation of traffic congestion arising from improved transport network The amount of pollution due to air emissions especially NO_2 and particulate matter are expected to increase or remain as a result of road transport.
Water pollution	C-	C+/-	**Co:** The amount of pollution is expected to increase temporarily due to construction works at river crossings and bay area. **Op**: Water pollution levels in rivers streams during operation phase might improve due to improved floodwater and drainage management systems associated with improved urban transport networks. As the infrastructure is improved, the number of residential, commercial and business facilities will increase and the amount of sewage will increase which may lead to pollution of rivers.
Solid Waste and/or Industrial Discharge	C-	C-	**Co:** Solid waste generation is expected to increase due to construction activities. **Op:** Generation of waste within passenger facilities for BRT and/or railway is expected.
Soil Contamination	C-	B+	**Co:** Trace contamination of topsoil can be expected due to mishandling of chemical materials. **Op:** Soil contamination is expected to decline in some parts of the city during operation due to improvement of sewage and storm water systems
Noise and vibration	B-	B+/-	**Co:** The noise and vibration is expected to increase temporarily due to construction activities. **Op:** The noise and vibration emission from vehicles (horns, and noise associated with car accident such as siren of ambulance) will be reduced due to improved road network and traffic conditions. There will be noise and vibration emitted from public transport such as railway and BRT.
Ground subsidence	C-	C-	**Co:** The extent of negative change in ground subsidence is unknown and will need further assessment. **Op:** Ground subsidence is likely to occur during operation due to changes in the underlying soil conditions which are associated with the upward movement of the underlying ground. Ground Subsidence may also be related to the moisture content of the soil underneath the foundations of roads and railway infrastructure. In addition, some geotechnical defects, such as initial compaction of the ballast bed and poor drainage condition of railway subgrade are also contributors to track geometry changes and railway subsidence.

Item	Rating		Impact predicted and Reason of the rating (A to D)
	Co	Op	
Odor	D	D	No impact is expected by the proposed urban transport master plan.
Sedimentation	C-	C+	**Co:** Deterioration of sedimentation can be expected in case of construction of roads/bridges at the river crossings and the estuary. **Op:** The level of sediment generation is expected to decline during operation due to improved drainage and transport condition.
Natural Environment			
Topographical/Geological Conditions	C-	C+/-	**Co:** The extent of negative change on topographical and geological conditions is unknown at the present stage. **Op:** Since the terrain will be changed due to construction of roads and public transport facilities, there will be negative change. The plan will stimulate organized urbanization which contributes to positive change.
Soil Erosion	C-	C+/-	**Co:** The extent of impact on soil erosion during construction is unknown at the present stage. **Op:** Since the terrain will be changed due to construction activities, there will be negative change. The plan will stimulate organized urbanization which contributes to positive change.
Fauna and Flora (Ecosystem)	B-	B-	**Co:** The fauna and flora of the estuary and bay area will be affected during construction in the area. **Op:** Although most of the areas in the city have already lost much of its original flora and fauna, the realization of the plan may accelerate degradation of nearby forest areas if appropriate measures are not taken.
Ground Water	C-	C+/-	**Co:** Ground water might be affected during construction phase if untreated liquid wastes reach these waters or it is over pumped for construction works or if underground transport systems will be established. **Op:** The level of ground water pollution might be decreased during operation due to improved drainage and organized urbanization. The ground water in newly urbanized areas might be affected due to the increased amount of waste water.
Water Body (River, Lakes, etc.)	C-	C+/-	**Co:** Water bodies such as rivers and streams will be affected due to construction works. **Op:** This will result into a minor negative impact on the natural hydrological regime of the area and might cause floods at some areas. Other negative hydrologic and drainage impacts are not foreseen.
Natural/Ecological Reserves and Sanctuaries (Protected Area)	C-	D	**Co:** Dar es Salaam has some protected areas including mangrove forests, which may be disturbed during construction. **Op:** Since the master plan is formulated to avoid development in protected areas, no impact is expected.
Local Climate	D	D	**Co and Op:** Since Dar es Salaam is along the coast, its local climate will not be affected by the proposed plan but will be influenced more by changes in sea wind.
Global warming	C-	B+/-	**Co:** The greenhouse gas emission will be increased

Item	Rating		Impact predicted and Reason of the rating (A to D)
	Co	Op	
			during construction phase due to increased movement of construction equipment. **Op:** Levels in global warming might slightly decrease during operation phase due to improved transport system that will reduce traffic jams in some parts of the city. Loss of green land resulted by improved / paved road network may cause a rise in temperature.
Social Environment			
Involuntary Resettlement	A-	D	**Co:** The magnitude of involuntary resettlement will depend on the design of the traffic network, but is expected to be higher in high densely populated areas of the city. **Op:** No impact is expected during operation.
Poor, indigenous, or ethnic people	C-	D	**Co:** Impact to poor people is unknown but it will depend on the decisions taken during construction phase to restore the livelihoods of the poor. No indigenous or ethnic people who will be affected by the proposed plan (See Section 2.2). **Op:** No impact is expected during operation.
Local economies (employment, livelihood, etc.)	B+/-	B+	**Co:** Local people are expected to be employed for construction and local economies will also be enhanced. Local economies may also be negatively affected depending on the scale of physical/financial resettlement. **Op:** Local economies will be enhanced especially in the newly urbanized areas.
Land use and utilization of local resources	B+	B+	**Co:** Utilization of local resources will be stimulated for construction **Op:** Improved transport system will stimulate more organized form of urbanization with defined land uses and systems.
Water Use	D	D	No impact is expected by the proposed urban transport master plan.
Existing social infrastructures and services	B-	B+/-	**Co:** Access to existing social infrastructures and services will be limited or disturbed due to construction works. **Op:** Due to reduction of traffic congestion during operation, access to key social services such as schools, hospitals, markets, shops etc., will be improved and as part of the improvement of the damaged infrastructures better ones might be developed. Some communities might be divided due to infrastructure development, which may result in deterioration of access to existing social infrastructures.
Social capital and social institutions such as local decision-making body	C	C-	**Co:** The extent of positive/negative impact is unknown. **Op:** Some communities might be divided due to infrastructure development, which may negatively affect social capital.
Misdistribution of benefits and damages	C+/-	C+/-	**Co:** There will be employment opportunities created in suburbs. Employment opportunity may unfairly be distributed. **Op:** Many will enjoy benefits associated with improved transport such as reduced health

Item	Rating		Impact predicted and Reason of the rating (A to D)
	Co	Op	
			problems, increased comfort and timeliness in transport. Some areas might be left with little access to public transport.
Local conflicts of interest	C-	D	**Co:** Employment opportunity may unfairly be distributed. **Op:** Unless the areas earmarked for transport network development have any relationship with key decision makers, no conflict of interest is foreseen.
Cultural heritage	D	D	**Co and Op:** There will be no impact on cultural heritage sites – except for areas that might have graves, which will be relocated as part of the resettlement program
Landscape	B-	B+/-	**Co:** Landscape will be temporarily deteriorated during construction. **Op:** There is some potential to encourage modal shift and sustainable travel, and increase accessibility opportunities which will help to reduce the impact of transport and improve the quality of urban landscape. Reducing the need to travel and encouraging modal shift is likely to result in landscapes being relieved of higher levels of traffic to some extent. On the other hand, construction of new roads/bridges and other transport infrastructure may negatively affect landscape.
Gender and Children's rights	C-	B+	**Co:** Gender and Children's rights are likely to be negatively affected in terms of access to employment in construction work and could also involve child labor. **Op:** The plan will ensure that women, men and children have equitable access to transport services and receive comparable social and economic benefits. The plan will promote greater equality of opportunity for all citizens, with the desired outcome of achieving a fairer society.
Infectious diseases such as HIV/AIDS	B-	B-	**Co:** The risk of increasing rates in HIV/AIDS infection exists especially during construction phase because may people may have disposal incomes. **Op:** The risk of increasing rates in HIV/AIDS infection is expected during operation because many people will be more mobile and able to reach various destinations for leisure.
Working conditions (including occupational safety)	B-	C+	**Co:** As the plan entails various kinds of construction activities, working conditions may not be of acceptable standards and levels during construction if no sufficient management and enforcement of rules will be secured. **Op:** The proposed plan will help to decongest the major roads currently experiencing frequent traffic jams, which will improve working conditions of the people who work on and along roads (traffic police, roadside vendors, etc).
Public Hygiene	C-	C+/-	**Co:** Public hygiene is likely to be worsen due to increased number of people in works sites. **Op:** The proposed master plan will allow positive environmental effects on energy use and air and

Item	Rating		Impact predicted and Reason of the rating (A to D)
	Co	Op	
			noise emissions. Environmental vectors such as air, water or soil which have potential to cause harm can be transported so that they come into contact with human beings.
Accident and Hazard	C-	C+/-	**Co:** Accidents may increase due to an increase of hazardous condition at construction sites, movement of machines, changes in roads and limited movements due to blockage of roads under construction, and trucks ferrying construction materials. **Op:** Accidents and hazards may decrease during operations due to improvement in transport network and reduction of jams. Accidents may increase on the proposed new roads which transverse villages.

Note: 1) A+/-: Significant positive/negative impact is expected. B+/-: Positive/negative impact is expected to some extent. C+/-: Extent of positive/negative impact is slight or unknown. (A further examination is needed, and the impact could be clarified as the study progresses) D: No impact is expected or expected impact is negligible.

2) Co: Construction phase and Op: Operation phase. Impact during construction is described to the extent that can be expected at the present stage.

9.7 Stakeholders' Engagement

9.7.1 Identification and Analysis of Stakeholders

A thorough understanding of stakeholders–who they are, what their concerns may be, what interests they have, is required in SEA process. The objective of stakeholders' engagement is to permit relevant stakeholders to participate in decision-making and keep the general population informed about the proposed DSM urban transport master plan. The process of identifying stakeholders entailed reviewing government ministries and institutions, public and private sectors as well as non-governmental organizations. The stakeholders are then categorized into three groups that are:

- Client Stakeholders Group,
- Key Stakeholders Group, and
- Other Stakeholders.

(1) Client Stakeholders Group

The Client Stakeholders Group (CSG) has overall responsibility for implementation of SEA. CSG initiates the SEA process, undertakes tasks required, procures technical inputs required to complete SEA, and manages development and adoption process. Administrative and financial responsibility shall remain entirely with this group, though some technical responsibility may be shared with other groups. CSG includes:

- PO-RALG
- DCC
- DSM-RAS
- JICA

(2) Key Stakeholders Group

The Key Stakeholders Group (KSG) acts as a focal point for discussion and consultation through development of SEA. The membership of this group should provide representation of the primary interests, and ensure consideration of all interests during revision of DSM urban transport master plan. KSG can be further divided into two groups: primary Key Stakeholders Group, who is the member of JCC, Secretariat, and/or Technical Working Groups, and secondary Key Stakeholders Group, who are not members of the above project organisation, but can be involved through meetings and workshops. Since the primary KSG is involved in those collaborative decision-making forums, certain responsibilities normally held by the CSG may be shared by the primary KSG to increase the level of stakeholder ownership.

The primary KSG includes:

- Ministry of Works, Transport and Communications
- Ministry of Land, Housing and Human Settlements Development
- Ministry of Home Affairs and Security
- Ministry of Finance and Planning
- VPO-Division of Environment
- TANROADS
- DART
- Road Fund Board
- SUMATRA
- TRC
- TAZARA
- Zonal Traffic Police
- Municipal Councils (Ilala, Ubungo, Kinondoni, Temeke, and Kigamboni)

The secondary KSG includes:

- Ministry of Agriculture, Livestock and Fisheries
- Ministry of Water and Irrigation
- Ministry of Health, Community Development, Gender, Elderly and Children
- Ministry of Industry and Investments
- Ministry of Energy and Minerals
- Ministry of Natural Resources and Tourism
- Dar es Salaam Water and Sewerage Authority (DAWASA)
- Marine Parks and Reserves Unit

(3) Other Stakeholders Group

There will always be a large number of individuals, public and private organisations who are likely to be affected by a proposed plan. It is not practical to involve all the stakeholders in one forum, therefore there remains a group of other stakeholders. This group is contacted directly by SEA consultant/practitioner. This group includes:

- Academic institutions – National Institute of Transport an Ardhi University
- Tanzania Truck Owners Association (TATOA)
- Transporters Association of Tanzania (TAT)
- Daladala Owners Association in Dar es Salaam
- Tax Association in Dar es Salaam
- Bodaboda Association of Tanzania
- Transport users

- Fuel station owners
- NGOs

9.7.2 Stakeholder Consultations

The methods involved for stakeholder consultation are:

✓ Individual meetings and focus group discussions: with key informants and representatives of stakeholder organizations

✓ Stakeholder workshop: municipality level (all five municipal councils in DSM) and national level

(1) 1st Stage: Scoping

During the scoping exercise, individual meetings and stakeholder workshops in each municipal council were undertaken. The objectives of consultation in this stage are:

✓ To introduce the study on revision of DSM urban transport master plan and SEA; and

✓ To obtain stakeholders' views and concerns.

The table below shows the stakeholders consulted at this stage.

Table 9.7.1 Stakeholders Consulted during Scoping

Date	Stakeholders
2017/7/13	MOLHHSD
2017/7/13	Kigamboni Municipal Council Workshop
2017/7/17	TRC / TAZARA
2017/7/17	Ilala Municipal Council Workshop
2017/7/18, 20	DCC
2017/7/19	Ministry of Water and irrigation / DAWASA
2017/7/20	TANROADS
2017/7/21	Ubungo Municipal Council Workshop
2017/7/24	Kinondoni Municipal Council Workshop
2017/7/24	Ministry of Agriculture, Livestock and Fisheries
2017/7/24	Ministry of Works, Transport and Communication
2017/7/24	SUMATRA
2017/7/25	Temeke Municipal Council Workshop
2017/7/25	Marine Parks and Reserve Unit
2017/7/26	DART
2017/7/26	Ministry of Health, Community Development, Genders, Seniors and Children

Source: JST based on Draft SEA Report for Updating the Dar es Salaam Urban Transport Master Plan

The issues of concern and interest to stakeholders are summarized as follows.

Pollution Control:

Concerns over air, noise & vibration, water pollution, etc

- Control mechanism to reduce pollution of air from carbon emission, noise pollution, vibration (from railway line) should be taken into account during the implementation of the plan.
- Buses and trains would generate a lot of noise and vibrations which could cause a lot of

disturbance in sensitive areas such as schools, hospitals and courts.
- Considering water quality, drains should not be directed into rivers.
- If the master plan is implemented as planned, it will result into a reduced fuel consumption and low air pollution.
- Environmental impact is generally expected during implementation of specific project especially during construction, which includes waste generation and management, soil erosion and siltation, air pollution, and disruption of other infrastructure such as water pipes and telecommunication cables.

Natural Environment:

Protection of reserves and ecosystem

- The water table in Pugu Kazimzumbwe, which is among the proposed satellite cities, is close to the surface, thus the satellite city should not disturb this as it is a collection point of water.
- The increased volume of people including tourists brought about by efficient transport system has the potential of marine ecosystem deterioration. Pollution of beaches and inshore habitats should be managed by appropriate institutions.

Flood risk

- Kongowe area is developing very fast, relatively low and has two major rivers namely Mkokozi and Mzinga. The master plan needs to take into account the flood risk.
- Drainage system has been a problem in several road projects.

Social Environment:

Involuntary resettlement & compensation

- Land availability will be a major problem in the implementation of the plan. Relocation and compensation will be required.

Provision of services to the socially vulnerable

- Design and measures should be taken to ensure safety and security of passengers, pedestrians, and people with different disabilities.

Local economy

- Implementation of the proposed master plan will help to reduce traffic congestion, which will result in the improvement of people's economy.
- Employment opportunities will be created during construction.

Public hygiene

- There is a need to raise awareness of public transport users to respect and protect the infrastructures. Toilet facilities and dustbins in main bus stations are not properly used.
- BRT started operation without toilets at bus stations.
- High congestion of people in public transport (BRT etc.) may result in spread of diseases.

Stakeholder engagement

- Involvement of municipal councils and other development stakeholders is important in the review and implementation of the master plan.

Landscape

- Roadside beautification should be considered.

Accident

- Major construction and operational activities would be associated with accidents.
- Railway should be bounded with fence to avoid accidents particularly for pedestrian crossing.

(2) 2nd Stage: Full SEA Study

Additional consultations including a combined municipal workshop and a national stakeholder workshop were conducted during full SEA study. The table below shows the stakeholders consulted at this stage.

Table 9.7.2 Stakeholders Consulted during Full SEA Study

Date	Stakeholders
2017/11/23	Kimbiji Ward, Kigamboni Municipal Council
2017/11/24	Ministry of Home Affairs (Traffic Department)
2017/12/19	Kawe Ward, Kinondoni Municipal Council
2017/12/22	Mabwepande Ward, Kinondoni Municipal Council
2017/12/28	Bunju Ward, Kinondoni Municipal Council
2018/1/15	Combined Workshop for 5 municipal councils
2018/1/26	National Stakeholders Workshop

Source: JST based on Draft SEA Report for Updating the Dar es Salaam Urban Transport Master Plan

The key issues raised by stakeholders during the combined municipal stakeholder workshop and the national stakeholder workshop are:

Stakeholder engagement

- Not only the government institutions but the community should have been involved in the process.

Land acquisition and compensation

- The community should be informed about the master plan especially on areas where the transport system will be constructed to avoid unplanned development, land use conflicts, disturbance or destruction of people's properties and high compensation cost.
- The acquired land for all proposed development should be appropriately compensated.

Non-Motorized Transport (NMT)

- Provision of infrastructure for non-motorized transport (bicycle and pedestrians) should be considered.

GHG emission

- Encourage service providers and government agencies to use gas for BRT buses in order to reduce GHG emission.

9.8 Evaluation / Assessment of Alternatives

9.8.1 Steps for Evaluation

A full SEA is carried out for the proposed urban transport master plan upon approval of scoping report and TOR by VPO-DOE. The following guiding steps will be taken:

(1) State the environmental protection objectives for DARTMP and summarize the policy implications, including alternative trade-offs and constraints;
(2) Specify and assess the range of options for achieving the objectives, including the "do nothing" option and state the preferred option with reasons for the selection;
(3) Consider the potential impacts (both positive and negative) of the recommended option on the environmental, socio-economic and cultural environment, including cumulative and residual impacts;
(4) Assess the significance of the impacts and provide possible mitigation or enhancement measures for the significant impacts to offset or enhance them; and
(5) Propose a monitoring and evaluation strategy for the proposed plan.

9.8.2 Environmental Protection Objectives

Application of environmental protection objectives is promoted as an appropriate tool for identifying and assessing the potential environmental effects, both positive and negative, of the master plan. In order to predict the effects of the Plan and key issues which need addressing can be identified, a thorough understanding of the context of existing policies and the current baseline characteristics of Dar es Salaam City is essential. In this study, the Environmental Protection Objectives were derived from a combination of the following considerations – all of which are based on best information available at the time of analysis including:

(1) Review relevant issues to the Dar es Salaam City as described in respective plans, programmes, policies, etc. (e.g. traffic congestion problems);

(2) Review the environmental characteristics, issues and problems of Dar es Salaam City; and

(3) Analysis of baseline data for Dar es Salaam City.

Subsequently, the selected SEA objectives in this study are as follows:
Objective 1: Safeguard and strengthen landscape quality and countryside against land degradation, erosion and contamination;

Objective 2: Conserve and enhance Dar e Salaam City biodiversity and geodiversity;

Objective 3: Conserve, protect/restore/enhance the historic and cultural sites, heritage assets and their settings;

Objective 4: Protect prime sensitive areas, open spaces and green belts;

Objective 5: Protect and enhance water quality/quantity, as well as soil and air quality, noise and vibration;

Objective 6: Reduce causes of and adapt to the impacts of climate change;

Objective 7: Protect seabed features - support processes, habitats & species characteristic of the marine landscapes; and

Objective 8: Improve socio-economic welfare and services of the people (e.g. transportation, health, incomes & employment levels).

9.8.3 Comparison of the Transport Master Plan Alternative

Based on the selected environmental protection objectives, the four alternatives were assessed and evaluated. The case which receives overall least negative scores was considered the most favourable in terms of environmental protection.

The assessment of the plan alternatives was done by identifying the likely changes to the baseline conditions as a result of implementing the proposed plan alternatives. These changes are described (where possible) in terms of their geographic scale, the timescale over which they could occur, whether the effects would be temporary or permanent, positive or negative, likely or unlikely, frequent or rare. Where numerical information was not available, the assessment was based on local knowledge, professional judgement and with reference to relevant legislation, regulations and policy including available national and international standards.

In this study, significance is used in the context of the whole of the environment covered by the whole plan area (the City of Dar es Salaam) and to the environment within which projects under the plan will operate individually or cumulatively. In the case of locally significant effects as a result of projects that may not be apparent or considered significant at this strategic level, these will be dealt with at project level ESIA under the plan. The significant changes are determined using significant rating scale defined as:

+3 Highly significant positive change

+2 Significant positive change

+1 Insignificant positive change

0 No change

-1 Insignificant negative change

-2 Significant negative change

-3 Highly significant negative change

The results of assessment of the four plan alternatives are summarized as follows:

Case 0 Do nothing alternative:

This represents the current situation. It is associated with highly significant environmental issues ranging from water pollution, air pollution, degradation of water bodies, beach and soil contamination resulting from unplanned settlement, poor drainage system and industrial sources causing deterioration of water quality, soil, and air quality. High traffic congestions in all roads all day in the city due to the concentrated urban structure contribute to significant level of air pollution from vehicle emissions.

Case 1 BRT incentive alternative:

This alternative proposes that the city be dispersed out with sub centers and satellite cities away from CBD. The satellite cities will perform some of the CBD functions away from the main CBD. This model reduces significantly the need to all people visiting the main CBD thus reducing traffic congestion. However, a number of BRT busses themselves will have significant contribution to air pollution due to emission. Similarly, limited railway services will still attract private owner to use

their vehicles thus contributing to air pollution.

Case 2 Railway Incentive Plan 1:

The plan focuses on developing more railway routes as per TRC plan, to service the outer ring connecting Kongowe, Pugu, Lugruni to Tegeta as one route; and the other route being from Kariakoo to Morocco, Mwenge, Tegeta up to Bunju, and extension from Lugruni along Morogoro road. In addition, this plan is to continue to maintain the existing TRL and TAZARA railway systems. In comparison to others, this scenario has a more extensive circular and radial railway system as per TRC plan. Environmentally, this scenario is likely to reduce greenhouse emissions as the number of BRT busses would be substituted by train commuter and the long distance route also would be served by train. However, this option would involve development of several terminal stations and facilities, which leads to substantial land acquisition and associated resettlement/compensation costs in relatively densely populated areas.

Case 3 Railway Incentive Plan 2:

The mode of transport within the planned urban structure constitutes the proposed BRT network covering phase 1-6 plus the Kigamboni route, middle ring route. This plan entails development of a larger railway network with a circular MRT plus long-term extension to Bagamoyo and Morogoro direction. The scenario is projected to meet the mass rapid transit more efficiently as the Circular MRT has a number of MRT stations that are strategically located to provide connections to other transportation systems operating within the city, and to contribute to development of urban structure. Infrastructure traversing densely populated areas would require substantial land acquisition. Similarly, traversing some of the regularly flooded areas would require expensive mitigation measures. In the long-run however, Case 3 railway incentive plan 2 would still be more environmental friendly as the mode of transport would be predominantly mass transit which would minimize the number of private vehicles and therefore minimize greenhouse gas emission from vehicle. The circular railway system promotes sub center development while avoiding backtracking and development of terminal stations. This would significantly reduce pressure on the CBD as this pressure is absorbed by the sub centers. It is also notable that the MRT and BRT transport systems would complement each other such that MRT is a long distance transport system, while BRT is a short-range system. This matches the vision of the DARTMP and would minimize congestion, traffic jams, and ensure convenience and comfortability to commuters.

Table 9.8.1 Assessment of Proposed Alternative Plans

Environmental Protection Objective	Alternative Development Scenarios			
	Case 0 Do nothing alternative	Case 1 BRT incentive case	Case 2 Railway incentive plan 1	Case 3 Railway incentive plan 2
Objective 1: Safeguard and strengthen landscapes quality and countryside against land degradation, erosion and contamination	-3	-2	-2	-2
Objective 2: Conserve and enhance Dar es Salaam Region biodiversity and geodiversity	-3	-2	-1	-1
Objective 3: Conserve, protect/ restore/enhance the historic environments, heritage assets and their settings	0	-1	-1	-1
Objective 4: Protect prime sensitive areas, open spaces and green belts	-3	-2	-1	-1

Objective 5: Protect and enhance water quality and quantity, soil and air quality, noise and vibration	-3	-2	-2	-1
Objective 6: Reduce causes of and adapt to the impacts of climate change	-3	-2	+1	+3
Objective 7: Protect seabed features - support processes, habitat & species characteristic of the marine landscapes	-1	-2	-2	-2
Objective 8: Improve socio-economic welfare of the people (e.g. health, income & employment levels)	-2	+1	+2	+3
Overall score	**-18**	**-12**	**-6**	**-2**
Ranking of the alternatives	**4**	**3**	**2**	**1**

9.8.4 Recommended Alternative Plan

From the analysis above, case 3 Railway incentive plan 2 is recommended as the Dar es Salaam Urban Transport Master Plan. The urban structure proposed under this alternative, together with various infrastructures proposed to service the urban structure and set up are analysed in detail in order to develop mitigation measures to improve the implementation of the plan for environmental sustainability and sustainability of the plan itself.

9.9 Comprehensive Assessment of the Recommended Plan

9.9.1 Major Potential Impacts

(1) Pollution Control / Public Nuisances

a) Air pollution and GHG emission (Global Warming)

The impact on air quality and climate change / global warming was estimated by multiplying emission unit by future traffic volume in 2040 for the M/P case and Do Nothing case. The emission unit is set by vehicle type and traveling speed as shown in the table below.

Table 9.9.1 Emission Unit

Traveling Speed		CO2 Emission Rates(g/km･vehicle)		NOx Emission Rates(g/km･vehicle)		PM10 emission Rates(g/km･vehicle)	
		Small Vehicle	Large Vehicle	Small Vehicle	Large Vehicle	Small Vehicle	Large Vehicle
1	100km<	120.9	614.7	0.075	0.425	0.002836	0.002836
2	90-100km	108.3	614.7	0.059	0.425	0.002018	0.002018
3	80-90km	98.7	614.7	0.048	0.425	0.001362	0.006167
4	70-80km	92.1	550.5	0.040	0.340	0.000868	0.005321
5	60-70km	88.8	515.5	0.037	0.289	0.000537	0.004925
6	50-60km	88.8	510.9	0.037	0.274	0.000370	0.004995
7	40-50km	92.5	536.3	0.041	0.295	0.000369	0.005557
8	30-40km	100.6	593.3	0.048	0.353	0.000540	0.006663
9	20-30km	114.8	684.4	0.059	0.450	0.000893	0.008435
10	10-20km	139.8	817.6	0.073	0.594	0.001461	0.011240
11	<10km	217.5	1105.7	0.073	0.594	0.001461	0.011240

Source: Grounds for Calculation of Vehicle Emission Factors to be used in Environmental Impact Assessment for Road Projects (FY2010 edition), National Institute for Land and Infrastructure Management, MLIT, Japan

Thanks to improved traveling speed and reduced vehicle kilometre, all calculated items i.e. CO_2, NOx and PM10 emissions are reduced in the MP case compared with Do Nothing case. CO_2 is reduced to 63%, NOx is reduced to 59%, and PM10 is reduced to 53% in total.

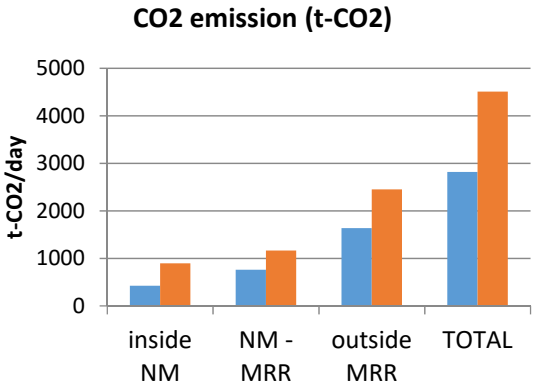


Figure 9.9.1 CO2 Emission

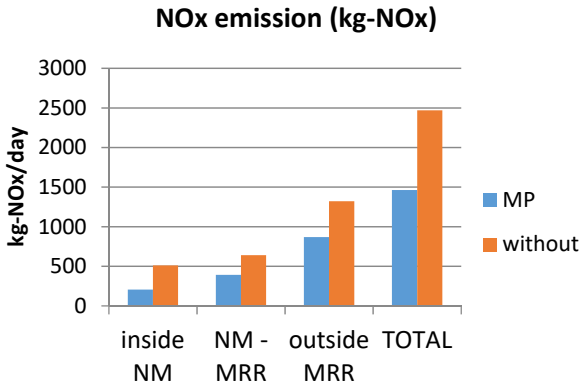


Figure 9.9.2 NOx Emission

Note: NM means Nelson Mandela Road and MRR means Middle Ring Road.

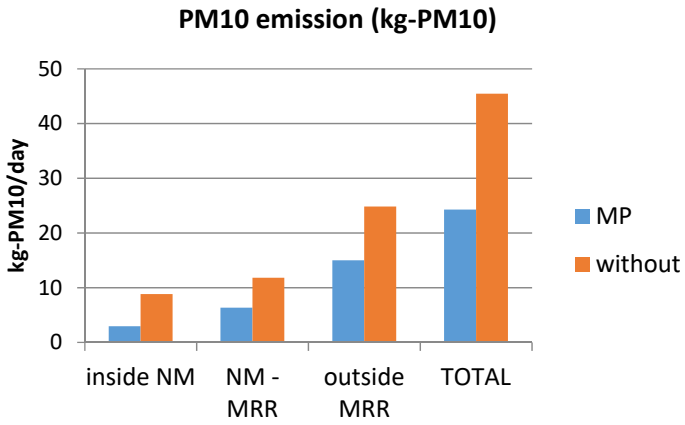


Figure 9.9.3 PM10 Emission

Note: NM means Nelson Mandela Road and MRR means Middle Ring Road.

b) Noise pollution

The noise level from moving vehicles in the city was estimated for the M/P case and Do Nothing case based on traffic volume, traveling speed, large vehicle ratio, and the number of lanes. The travel speed is regarded as a variable of congestion degree. Travel speed pattern is classified in four, which are called A, B, C, and D in this study as shown in the table below.

Table 9.9.2 Travel Speed Pattern

Travel Speed Pattern	A	B	C	D
Congestion Degree	<0.75	0.75 – 1.25	1.25 – 1.75	1.75<
DAY	40 km/h	30 km/h	20 km/h	15 km/h
NIGHT	40 km/h	40 km/h	40 km/h	15 km/h

Note: Day time is from 6:00am to 10:00pm and night time is from 10:00pm to 6:00am. The traveling speed is set based on traffic survey results.

The traveling speed pattern ratio in Do Nothing case and M/P case is shown in the figure below. In M/P case traffic congestion will be greatly improved owing to the implementation of M/P, which results in higher traveling speed.

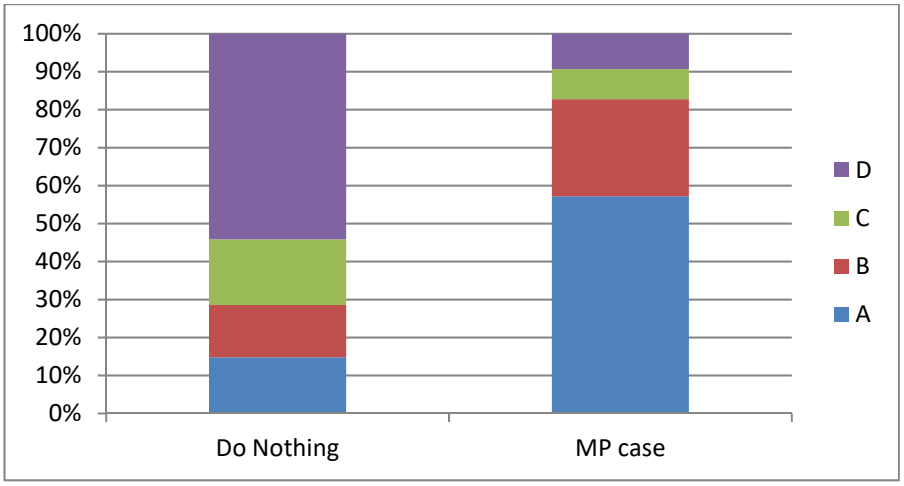


Figure 9.9.4 Traveling Speed Pattern Ratio in Do Nothing Case and M/P Case

The figure below shows link length by noise range. The noise level from a moving vehicle generally increases as travel speed increases. In the case of M/P implementation, a section with a high noise level (65 – 70dB) increases compared with Do Nothing case. This is attributed to the increase in traveling speed due to improvement of traffic flow by M/P implementation. In reality, when there are traffic jams, noise due to traffic accident and/or horn occurs, which is not included in calculation.

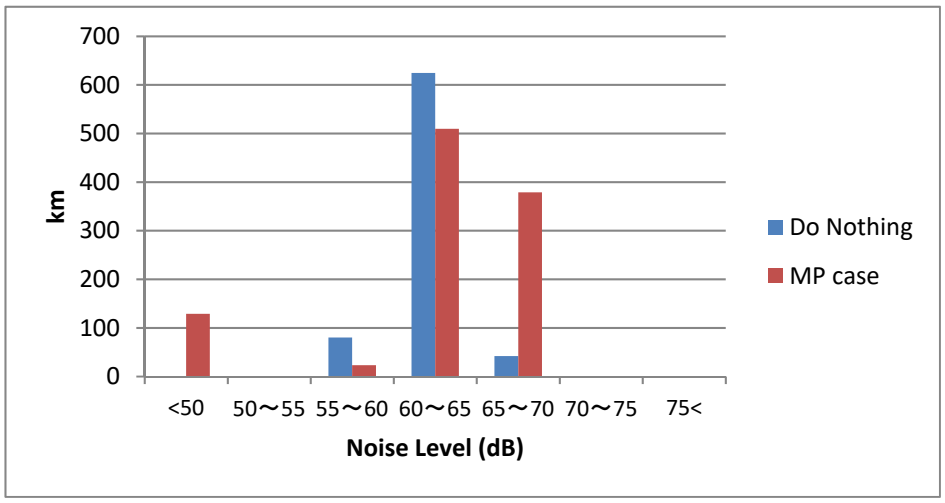


Figure 9.9.5 Link Length by Noise Range

As shown in the table below, 70dB is the maximum permissible noise level for industrial area on day time. Since it is inevitable that the noise level increases as the traveling speed increases, it is important to manage so that the noise level does not exceed the standard. Management measures include but not limited to: to conduct noise level monitoring and to conduct EIA in individual infrastructure development projects and introduce noise countermeasures.

Table 9.9.3 Maximum Permissible Noise Levels for General Environment

COLUMN 1	COLUMN 2	
FACILITY	NOISE LIMITS dBA (Leq)	
	DAY	NIGHT
A. Any building used as hospital, convalescence home, home for the aged, sanatorium and institutes of higher learning, conference rooms, public library, environmental or recreational sites.	45	35
B. Residential building	50	35
C. Mixed residential (with some commercial and entertainment)	55	45
D. Residential and industry small–scale production and commerce	60	50
E. Industrial area	70	60

Source: Environmental Management (Standards for the Control of Noise and Vibration Pollution) Regulations, 2011

(2) Natural Environment

a) Impact on biodiversity

The main threats to biodiversity are likely to be an expansion of transport network for roads, railway, and supporting infrastructures as proposed in the DARTMP. The construction of the missing link i.e. new Selander Bridge will impact marine biodiversity while development of outer ring road will accelerate degradation of nearby forest areas. Similarly, dispersion of the city with development of proposed urban structure with associated infrastructures will contribute to biodiversity loss as majority of the city dwellers are still using charcoal as a source of energy.

b) Global warming

See (1) a) Air pollution and GHG emission (Global warming) above.

(3) Social Environment

a) Enhanced socio-economic welfare of the people

The development of the proposed DARTMP has highly significant positive potentials. The implementation of the plan to develop urban structure that promotes development of nodes such as sub centers and satellite cities will stimulate economic activities of the city. Associated with growth of sub centers and satellite cities, growth of business and service sector which will boost the economy is expected. Similarly, the improved transport system will ease transfer of goods and services to market place and reduces delay and time wasted on traffic jam. Improvements in transport infrastructure will help in terms of access to market, movement of goods and commodities as well as increased trade among the people within the city and the country at large.

b) Employment and job creation

Development of the proposed master plan would provide employment and create job opportunities to people from the city and nearby town centers like Bagamoyo, Kibaha, Mkuranga and Kisarawe. People would acquire skills for construction and management or operation of multiple transport system, traffic management and others.

c) Land acquisition and involuntary resettlement

The planned infrastructure development such as railway, roads and feeder roads and expansion of some of existing road will require land acquisition. The process of land acquisition may lead to inevitable displacement of houses and commercial buildings causing inconvenience and disruptions to the affected families and businessmen.

d) Disruptions of social/ public infrastructure

Most of public infrastructure such as water pipes, electricity and telecommunication cables are installed along the major road services. Expansion and construction of new roads and railways will certainly disrupt the infrastructure services and cause inconvenience to service providers and the general public.

e) Contribution to landscape changes

Development of roads for BRT phase 1-6 of the plan, railway to cover the plan and feeder roads will contribute to significant change in landscape. The proposed sub centres and satellite cities are located on the outskirts of Dar es Salaam which is characterized by hilly and undulating terrain as compared to the current CBD area. Thus, development of infrastructure to connect these urban structures may negatively affect the landscape of the outskirts of Dar es Salaam.

f) Social delinquency and infectious diseases such as HIV/AIDS

The creation of job opportunities in the satellite cities and sub centres both at construction and operation phases are bound to increase the number of people due to migration of job seekers. Due to influx of people, the social interaction between the community and migrants will certainly occur. Different areas which have been proposed for the development of satellite cities have varying level of income, with most of them in Kongowe, Luguruni, Mabwepande, Kimbiji, etc. are of low income with higher unemployment rates. Since most of the workforce during construction are young and are in active age of reproduction, there is bound to have social relations that predispose both parties to sexually transmitted diseases including HIV/AIDS.

(4) Cross-Cutting Issues

a) Increased energy demand and use

The implementation of the DARTMP will increase the demand for fuel energy. Regardless of the mode of transport infrastructure, trains, BRT busses and express busses all need energy to operate. Any increase in demand will significantly trigger fuel shortage considering the fact that Tanzania depends on imported fuel unless strategies for improved country fuel reserve are implemented.

9.9.2 Enhancement / Mitigation Measures

This section presents the recommended enhancement and mitigation measures for various impacts predicted for the recommended alternative plan. The enhancement and mitigation measures are developed for impacts that area considered significant and the analysis has pooled together the impact of various projects to be implemented in the recommended master plan.

Table 9.9.4 Enhancement / Mitigation Measures

S/N	Significant Impact	Enhancement/Mitigation Measures
Positive impacts		
1	Enhanced socio-economic and welfare of the people	• The Government should ensure that the proposed master plan and all proposed project under the plan are fully developed to realize its full benefit. • Enhance institution and sector coordination among various actors under the proposed plan. • Planned industrials and other drivers of the economy be developed to benefit from improved transport system.

S/N	Significant Impact	Enhancement/Mitigation Measures
2	Employment and job creation	• Government to promote training of human resources to take leading roles in job creation and available opportunities • Technical training to job seekers should be provided to maximize emerging job opportunities. • The Government should ensure that the proposed master plan and all proposed projects under the plan are fully developed to realize its full benefit. • Enhance institution and sector coordination among various actors under the proposed plan.
Negative impacts		
1	Air Pollution and GHG emission	• The Government to diversify clean energy sources. • The Government to institutionalize policy advocating clean energy production and development of green economy.
2	Noise Pollution	• The Government to monitor noise level especially in primary sensitive areas and residential areas on arterial roads • The Government to formulate / enforce penal provisions on wasteful horn • The proponent of each project to conduct EIA and to introduce noise countermeasures
3	Biodiversity change	• Establish and adhere to land use plan to guide development of the sub centers and satellite cities. • Comprehensive ESIA should be carried out for all planned projects prior to commencement of the implementation activities. • Enhance institutional coordination and cooperation for a holistic execution of the master plan.
4	Land acquisition and involuntary resettlement	• Authorities responsible for the development of roads and railway infrastructure development should prepare Resettlement Action Plans where displacement will be necessary.
5	Disruptions of public infrastructure	• Ensure proper institutional coordination among all stakeholders and public utility service providers such as DAWASA, TANESCO, SUMATRA, telecommunication companies and municipal councils to minimize any disruption of services at the implementation stage. • Liaise with the implementing agency regularly to get information on the existing and future uses of services.
6	Contribution to landscape change	• All proposed project under the plan must be subjected to ESIA study prior to its commencement. • Proposed design of the infrastructure must comply with respective standards that protect landscape and seascapes.
7	Social delinquency, HIV/AIDS and Sexually Transmitted Diseases	• The responsible municipal councils and contractors should provide adequate education and undertake sensitisation workshops for workers and communities around satellite cities on HIV/AIDS. • Work closely with various HIV/AIDS organizations in order to achieve the best result.
8	Increased energy demand and use	• Transport infrastructures proposed should be designed to utilise modern technology that is environmentally friendly. • Explore the use of clean energy on busses and electric trains to minimize pressure on diesel requirement.

9.9.3 Monitoring

Regular collection of data and monitoring based on coordination of various actors under DARTMP is mandatory for efficient management of the proposed master plan. Monitoring must be built in the master plan and taken as integral part of the implementation of the proposed master plan in order to collect data that will be used to inform future revisions and changes for sustainability of the plan and the recipient environment. Resources must be allocated for this task otherwise future revisions will have no basis for any proposed changes.

Table 9.9.5 Recommended Indicators for Monitoring

Sustainability issues	SEA Objective	SEA indicator
Air quality and GHG emission	Minimize gas emission due to the vehicular /locomotive pollution due to DARTMP implementation. Minimize contribution to climate change due to emission of greenhouse gases with appropriate energy source mix.	- Estimated emission levels from vehicular and locomotives (within existing lines) for gases and particulate matter (e.g. Carbon Dioxide) - GHG emission from vehicle /locomotive pollution
Noise pollution control	Minimize noise pollution caused by infrastructure development proposed in DARTMP	- Noise level along arterial roads and railway lines
Biodiversity and landscape change	Prevent damage to terrestrial and aquatic and soil biodiversity, particularly designated habitat sites and species.	- Status of protected areas/reserved areas - Loss or deterioration of priority habitat/species
Social wellness (Land acquisition and involuntary resettlement, and disruptions of public / social infrastructure)	Minimize disruption and displacement to the local population Maintain and improve local environmental and health quality including reduction of diseases associated with transportation	- Livelihoods of affected persons as a result of the implementation of the DARTMP. - Number of reported cases associated with grievances arising from resettlement - Number of traffic accident
Social delinquency, HIV/AIDS and Sexually Transmitted Diseases	Prevent increase in HIV/AIDS and other diseases Prevent increase in crime rate	- Morbidity of HIV/AIDS and other diseases - Crime rate
Increased energy demand and use	Minimize use of non-renewable resources	- Status of water catchment areas and environmental flows - Rate of deforestation on nearby forest reserves and green belt after implementation of the projects under DARTMP

9.10 Recommendations for Effective Implementation of the Master Plan

The recommended urban transport master plan with its corresponding urban structure will trigger various environmental and social changes that will need to be addressed to ensure that the desired development does not adversely affect the environmental base and enhance socio-economic development. To ensure sustainable social welfare, economic growth, and environmental sustainability, the following specific recommendations are provided.

(1) Detailed Feasibility Assessment of the Proposed Developments

The proposed corridors for railways and roads plan under DARTMP have not been fully assessed in detailed information on the particular corridors. It is recommended that all chosen corridors be subjected to detailed feasibility study to establish their economic, environmental, and social status in relation to the proposed plan and development target.

(2) Undertaking of Detailed ESIA for Projects and Urban Structure Development

The proposed routes are subject to a detailed ESIA assessment to comprehensively identify environmental and social impacts and suggest means of enhancing the positive benefits and mitigation measures for negative impacts arising from the implementation of each of the proposed projects. It is recommended that detailed ESIA be carried out for all projects to be implemented under the master plan including projects that will be implemented to support development of the proposed urban structure (sub centres and satellite cities).

(3) Establishment of the Organization Responsible for Coordinating Activities of the Master Plan

There has been a major problem in coordinating various activities or projects taking place within the county involving more than one ministry or institution. Given the nature of the DARTMP and associated urban structure development, there are a number of projects that will be implemented by various institutions from different ministries. Thus, the coordination of the various activities will be paramount. This SEA recommends the establishment of a specific organization involving various sectors (railway, urban planning, environment, roads, land, etc.) touched by the DARTMP to coordinate the implementation of the plan.

(4) Capacity Building for Staff to Operate and Manage the Infrastructures

Capacity building (in terms of number of staff, skills and expertise) is needed to equip staff with the necessary capabilities to handle, operate, and manage the various activities of the DARTMP including implementation of various mitigation measures under this SEA as well as those that will be developed by specific ESIA for specific project.

(5) Choose Option that Minimize Land Acquisition and Associated Compensation

It is recommended that land take and compensation costs be part of the criteria to be used for corridor selection- corridors that minimize massive land take and high compensation be selected for development. To minimize the anticipated land acquisition and compensation issues, choice of appropriate technology such as flyover, or underground railway system or roads intersection should be considered in order to avoid massive resettlement.

CHAPTER 10 REVISION OF COMPREHENSIVE URBAN TRANSPORT MASTER PLAN WITH SECTOR PROGRAM

10.1 Land Use Plan

10.1.1 Urban Function Distribution Plan

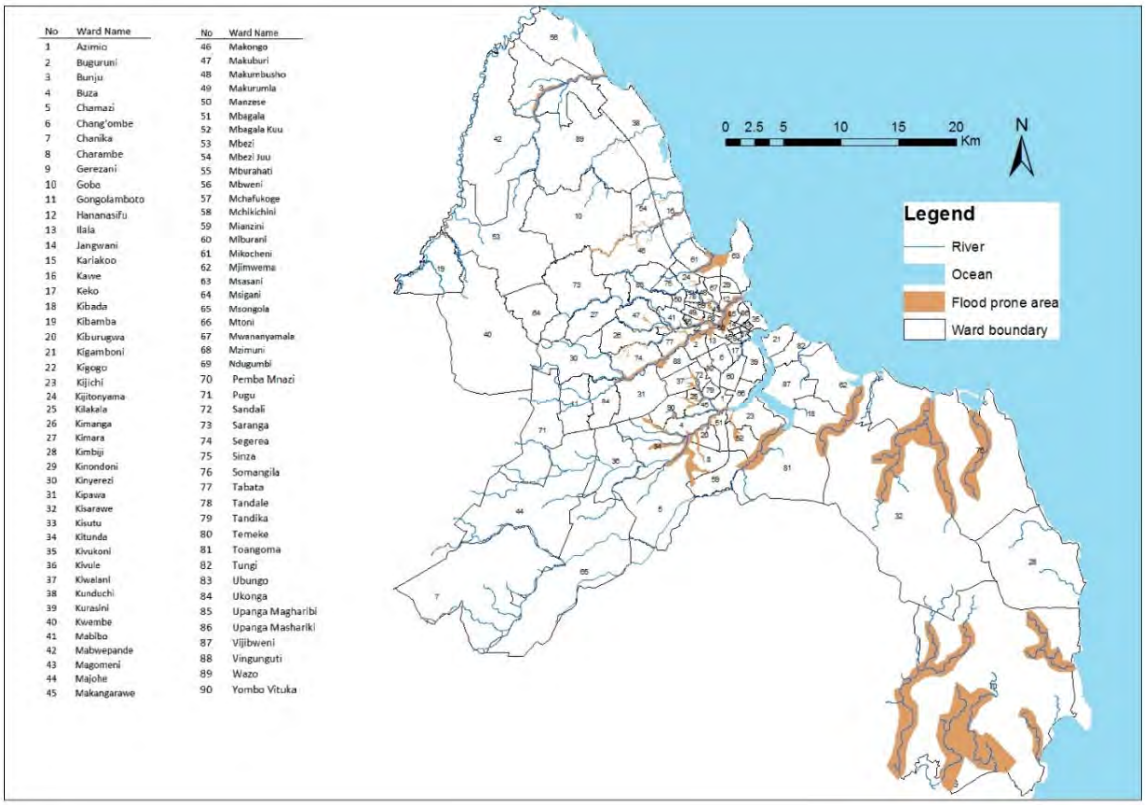
(1) Identification of Suitable Areas for Development

Living in safe areas and protecting natural environment is important to prepare land use plan. Lives of people and property should be protected from natural disasters. Protecting forest and coastal environment is also important for liveable life.

To set land use directions, JST identified flood-prone areas, protected areas, and steep slope areas. These areas are not suitable for development, so the remaining area is regarded as the suitable area for development. (Figure 10.1.3)

a) Flood Prone Area

Figure 10.1.1 shows flood-prone areas in DSM. Fairly large flood prone areas are distributed in Kigamboni. There are also flood prone areas along the Msimbazi River, the Kizinga River, and the Mzinga River. The Msimbazi River runs through Ilala Municipality. Other two rivers run through Temeke Municipality and Kigamboni Municipality. Kinondoni and Ubungo Municipalities have small floor prone areas.



Source: JST identified based on satellite image

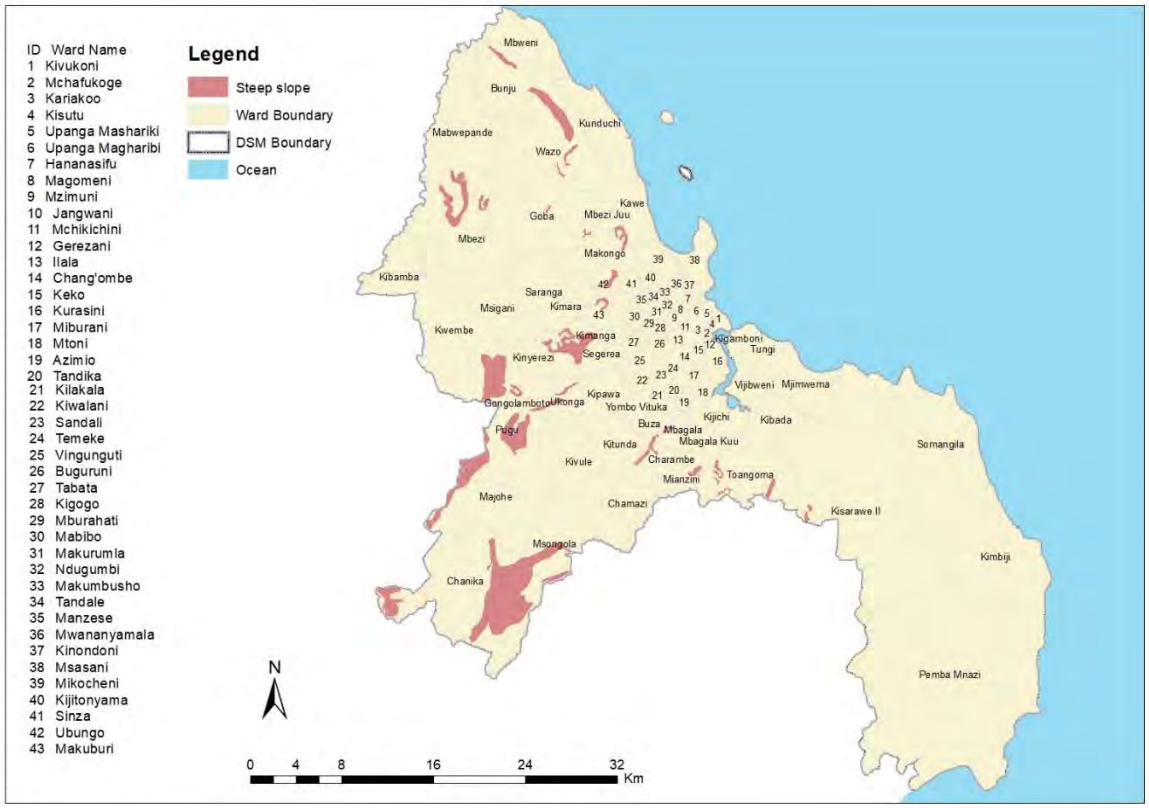
Figure 10.1.1 Flood Prone Area in DSM

b) Protected Area

Protected Area in DSM is shown in Figure 2.1.2 in Chapter 2. Forest area within DSM boundary is small. Only Pande Game Reserve and a part of Pugu Forest Reserve and Kazimbumbwi Forest Reserve are located in DSM. Large protected areas such as Ruvu North Forest Reserve and Ruvu South Forest Reserve are located outside DSM.

c) Steep Slope Area

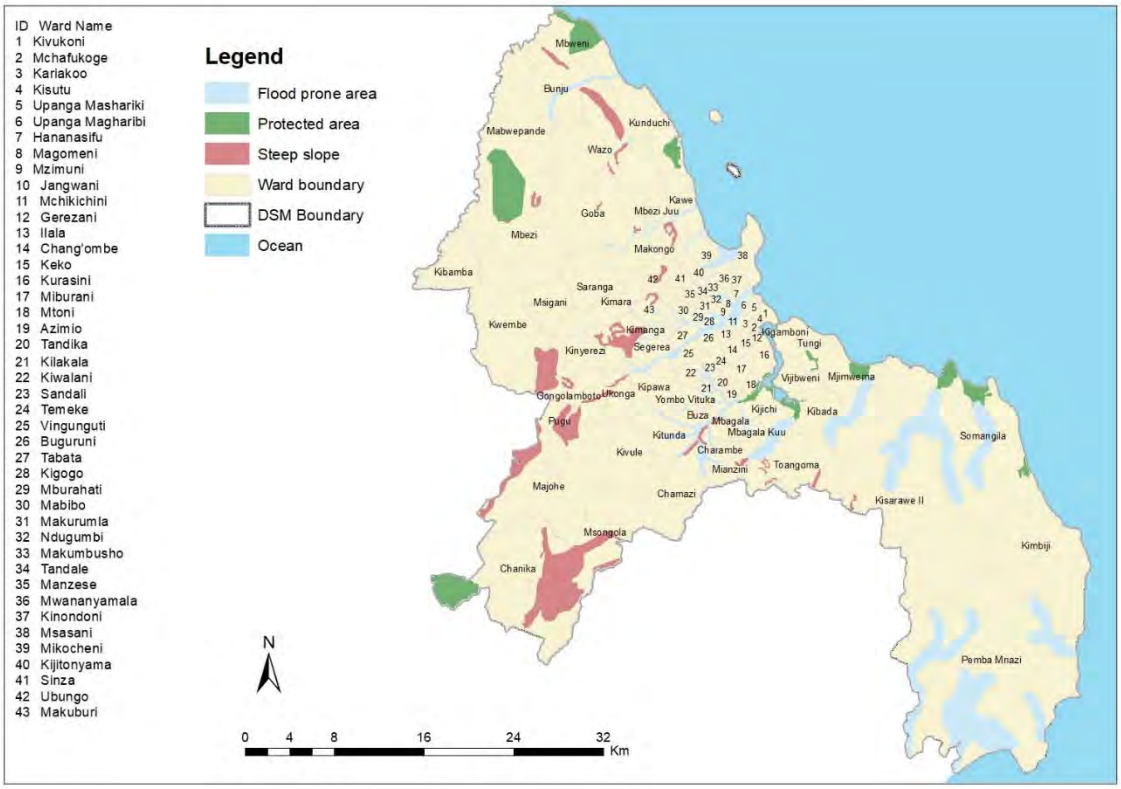
Figure 10.1.2 shows steep slope areas which have more than 30% slope. The areas are not suitable for development and have risks of landslide. The steep slope areas are distributed beyond 15km from CBD. There are large areas of steep slope in Chanika, Msongola, Pugu, Kwembe, Mbezi, and Wazo. Kigamboni does not have steep slope areas.



Source: JST identified based on satellite image

Figure 10.1.2 Steep Slope Area in DSM

Figure 10.1.3 shows the unsuitable areas for development in DSM by overlaying flood-prone area, protected areas, and steep slope areas mentioned in (1) to (3).



Source: JST

Figure 10.1.3 Unstable Development Area in DSM

(2) Directions to Distribute Urban Function in DSM

Based on the proposed urban structure of Case 2 and discussion of TWG-1, JST has considered an urban function distribution plan. Mentioned here is how to distribute residential area, commercial and business area, industrial area, key public facilities such as school and health facilities, and open spaces.

a) Residential Area

Introducing residential functions in CBD is promoted to provide an option taking advantage of proximity between residence and work place.

Areas within 10km from CBD and outside of CBD border would be developed as highly dense residential areas, which density is more than 200 persons/ha. This level of the density is corresponding to four or five storey flat/condominium area. These types of the residential building are commonly used as multi-storey type public residence buildings in Tanzania.

Fairly high-dense areas, which density is between 160 persons/ha and 200 persons/ha, would be distributed in satellite cities and along inner ring road. Medium-dense areas, which density is between 80 and 160 persons/ha, would be distributed along the arterial roads and outer ring road. Residential areas in satellite cities are coupling with other functions such as commerce and business, and social functions including schools and health facilities.

b) Commercial and Business Area

Commercial and business areas are currently located in CBD. The areas will be also developed in sub-centres and satellite cities, in addition to CBD. Existing small-scale informal commercial and trading activities near planned site of satellite cities would be accommodated in markets developed

in satellite cities. These areas will be developed near transport hub such as train stations and BRT terminals at sub-centres and satellite cities to be convenient and encourage modal shift from private vehicle use to public transport use.

c) Industrial Area

The expansion of industrial areas is not considered at the existing industrial area located along TRL line and Nyerere Rd. in Ilala Municipality and Export Processing Zone in Ubungo Municipality. New industrial development will be promoted outside of DSM. According to Export Processing Zone Authority (EPZA) under Ministry of Industry, new industrial development would be promoted in Bagamoyo with new port development and Special Economic Zone development. EPZA also would promote development of new industrial areas in Kibaha, Kisarawe, and Mkuranga. JST follows the development direction of EPZA for the distribution of industrial areas.

d) Key Public Facilities

Locations of key public facilities such as education facilities, health facilities, etc., will impact the traffic. Education facilities cause the concentration of the trips by students and teachers. Health facilities cause the concentration of the trips by the patients, attendants, and doctors.

To avoid the concentration of the trips, education facilities and health facilities are to be developed not only at CBD and but also at sub-centres and satellite Cities. For educational facilities, provision of all levels of educational facilities such as primary, secondary, and tertiary institutions including university are examined in each satellite City.

e) Green and Open Spaces

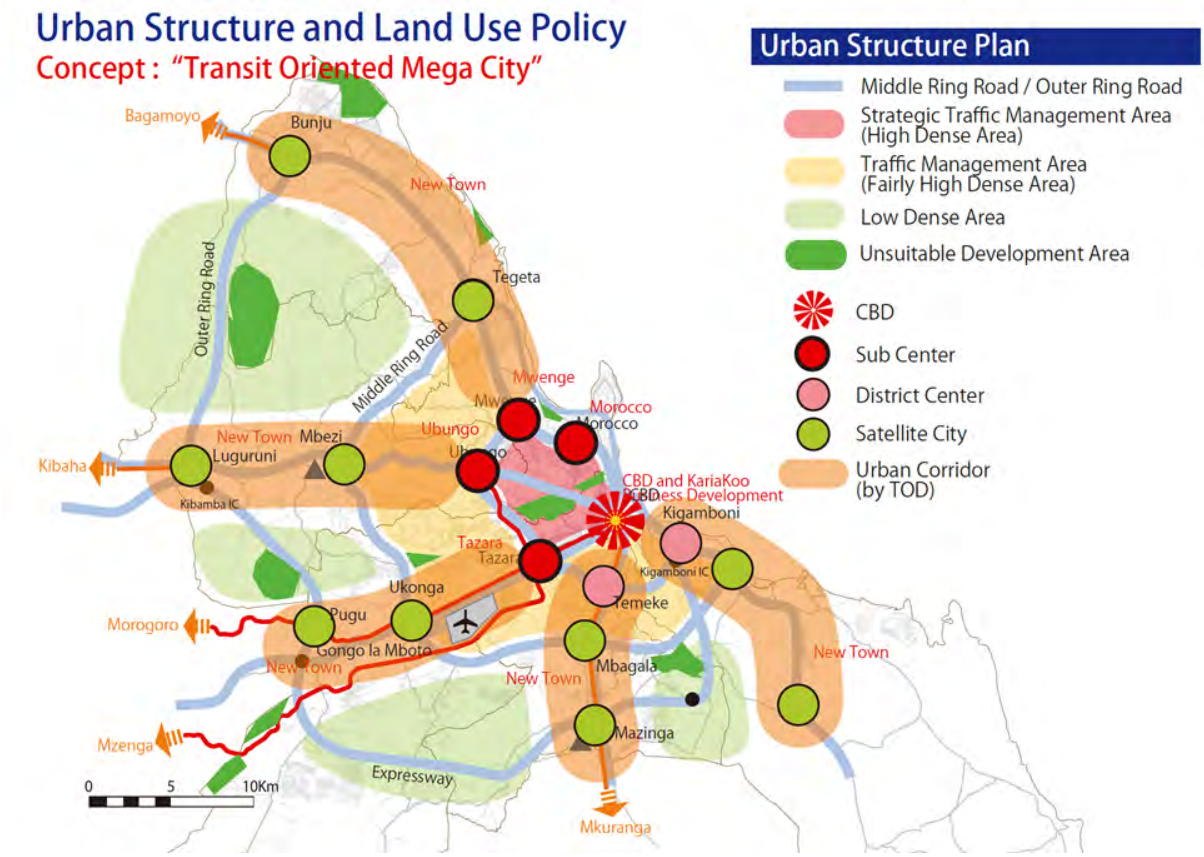
Pande Game Reserve and a part of Pugu Forest Reserve and Kazimzumbwi Forest Reserve provide precious green areas in DSM. Flood-prone areas along the rivers are also open spaces. Harbour and coastal lines are also open spaces. These areas should be protected.

Small open spaces such as existing parks and sports facilities should be secured. Plus, creating small open spaces through the development of buildings and provision of parks and sports facilities are also encouraged.

(3) Land Use Policy in DSM

Land use policy in DSM based on the above considerations is as follows. Figure 10.1.4 shows the policy with a map. This land use policy was set through discussion among JST and stakeholders in Tanzania. This policy will be integrated in future land use of Dar es Salaam Master Plan.

- To form sub-centres and satellite cities for reducing concentration of urban functions to CBD;
- To form urbanized areas along urban axis or corridors such as Bagamoyo Rd. Morogoro Rd., Nyerere Rd., and Kilwa Rd.;
- To avoid protected areas and unsuitable areas for development such as flood-prone areas and steep slope areas; and
- To promote Transit Orient Development at urban cores such as CBD, district centres, sub-centres, and satellite cities for achieving modal shift from private vehicle use to public transportation use



Source: JST

Figure 10.1.4 Urban Structure and Land Use Policy

Details on legend of Figure 10.1.4 are summarized as shown in Table 10.1.1

Table 10.1.1 Details of Legend

Legend	Description
High Dense Area	Area where population density is more than 20,000 persons/ha
Fairly High Dense Area	Area where population density is more than 16,000 persons/ha and below 20,000 persons/ha
Low Dense Area	Area where population density is below 8,000 persons/ha
Protected Area	Area such as a forest should be protected
Unsuitable Development Area	Area which is flood-prone and has steep slopes, not suitable for development
CBD	Representative Business and Commercial Centre
Sub Centre	Second-level Business and Commercial Centre
District Centre	Area which main function is district-level administrative services
Satellite City	Area which has residential functions as well as business and commercial functions
Urban Corridor	Populated area along a main road

Source: JST

10.1.2 Policy on Land Use in CBD

CBD plays an important role to share its urban function with Sub-centres and Satellite Cites and to keep functions as a business centre of DSM for the target of forming a "Sustainable Urban Structure". Developing land use policy for CBD is important to guide the development of CBD to make DSM a "Transit Oriented Mega City" by forming "Sustainable Urban Structure". This policy will be integrated in future land use plan of Dar es Salaam Master Plan.

(1) Current Situation

CBD has sustained the urban functions of DSM and played an important role of being Tanzania's economic centre. Most of commercial and business activities are concentrated in CBD. The central and local government institutions, banks and private businesses' activities are concentrated in the areas of Mchafukoge and Kivukoni. Wholesale and retail commercial activities are concentrated in Kariakoo and Mchafukoge. Historical buildings are also scattered in CBD. Some government functions are moving to Dodoma.

(2) Issues

CBD is a centre which has a variety of urban functions in DSM. High rise business and residential buildings are being constructed at a few places in CBD, so the number of trips both concentrated to the buildings and generated from the buildings will increase in future. It is difficult to increase road capacity especially by developing new roads in CBD. Encouraging public transport use by enhancing connectivity among the transport mode is one of the issues.

Enhancing attractiveness is also an issue because pedestrians at on weeknights and weekends are few. How to utilize locational advantage is to be considered for enhancing the attractiveness.

We also need to address the issue of how to use the lots where the national government functions are located. Redevelopment as business and commercial function is one of the options, but providing open spaces is also another.

JST prepares preliminary land use policies to address the issue by conforming to the vision and viewpoints.

(3) Contribution of CBD to Targets of UTMP Vision

This UTMP has a vision of "Transit Oriented Mega City". The targets to attain the vision are: i) Sustainable Urban Structure, ii) Vital Economy with Efficient Activities, iii) Society with Equal Opportunities for all, iv) Quality of life with Safe & Good Environment.

Future land use of CBD shall contribute to attaining these targets and vision. CBD shall play an important role in attaining the target of "Sustainable Urban Structure" by enhancing attractiveness of CBD and convenience for commuters, visitors, and residents, to revitalize CBD.

Enhancing attractiveness of CBD will lead to an increase in the visitors to CBD and contribute to activating business activities in CBD. It also will contribute to attaining the target of "Vital Economy with Efficient Activities".

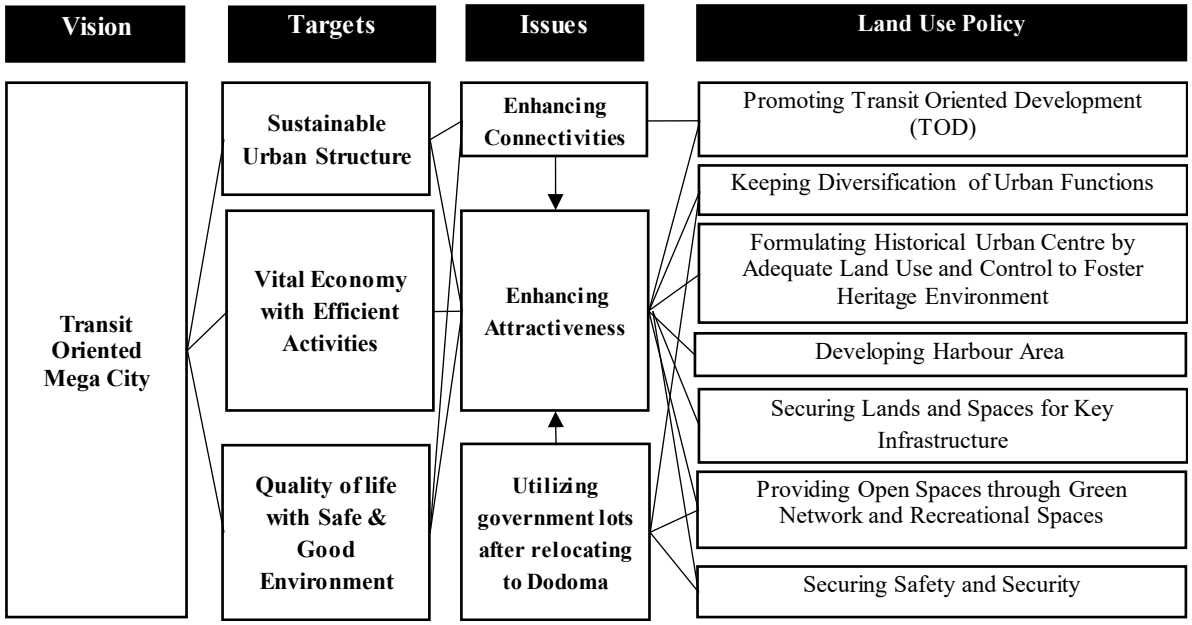
Enhancing attractiveness around transport nodes as well as enhancing connectivity between transport nodes and buildings for business and commercial purposes is also a key to promote TOD and encourage modal shift from vehicle users to public transport users. Enhancing attractiveness of CBD also contributes the target of "Quality of life with Safe and Good Environment" through promoting TOD.

The target of "Society with Equal Opportunity for all" is mainly realised by operational measures of public transport mode. Land use policy here focuses on contribution to other three targets.

(4) Policy of Land Use in CBD

CBD is the only existing urban core of DSM. CBD will keep playing a significant role in future urban structure of DSM, so it is important to address the above issues and develop land use policy for CBD to be shaped as an attractive area.

To address the issues and to shape DSM as the vision states, the following policies should be set for land use in City Centre. Figure 10.1.5 shows relationship among vision, viewpoints, and land use policy in City Centre.



Source: JST

Figure 10.1.5 Relationship among Vision, Targets, Issues, and Land Use Policy in CBD

a) Promoting Transit Oriented Development (TOD)

- Smooth movement and transport would be promoted by transit-oriented development which encourages modal shift from automobile use to public transportation use. Increasing road capacity to meet the increasing demand is difficult, so modal shift would be promoted. Not only development of transport nodes such as MRT station, but also enhancing attractiveness of the areas by applying the policies to be mentioned from b) to g) should be considered.

b) Keeping Diversification of Urban Functions

- Some urban functions will be dispersed to satellite cities and sub-centres, but CBD will keep diversity of urban functions to attract citizens and visitors with convenient services as well as providing spaces for business in CBD.
- Some national government functions which deal with business license, taxation, and trading will remain to be conducive for economic activities in CBD, though most of national government functions will move to Dodoma.
- MICE function will be introduced to be able to attract international conferences or regional conferences of Eastern African Nations.
- Short trip between residence and working place by promoting residing in the CBD through mixed use development will be increased.

c) Formulating Historical Urban Centre by Adequate Land Use and Control to Foster Heritage Environment

- Areas in CBD where the historical buildings are scattered would be maintained with certain regulation not only to protect the building themselves but also to safeguard historical environment.
- Land use planning for the historical centre would play a significant role in formulating an attractive and comfortable urban environment through traffic management in the area, such as public parking system, pedestrian network, and land use encouragement such as historical building conversion to attractive culture or commercial facilities, and urban design to fit with historical building land scape.

d) Developing Harbour Areas

- To provide comfortable environment to citizens and visitors, water front development will be promoted by taking locational advantage along the harbour.

  Passengers' terminals for boat and ferry passengers will be improved to enhance connectivity with public transport such as BRT, taxi, and Daladala.

e) Providing Open Spaces through Green Network and Recreational Spaces

- Trees and green spaces especially in the eastern part of the CBD should be retained and created to formulate linkage and spots as park and recreational spaces as part of an ecological green system.
- Some plots where the government functions move to Dodoma and release the land would be converted to open space.
- Park system for a liveable environment should be established to serve the local community. Public spaces such as a public square shall be connected through walkway along the coast and the harbour.

f) Securing Lands and Spaces for Key Infrastructure

- To build a resilient CBD, key infrastructure such as drainage and pumping stations to lower flood disaster risks will be developed. Spaces for key infrastructure should be secured.

g) Securing Safety and Security

- Number of pedestrians will increase by encouraging mixed use development as well as policies of a) to e), to decrease crimes, because crimes generally occur in less crowded places.
- To form attractive CBD, safe space for pedestrians such as sidewalks, squares, and transit malls should be built. Transit mall is where automobile traffic is prohibited or greatly restricted and only public transit vehicles, bicycles, and pedestrians are permitted.
- Pedestrian bridges connecting a building to another building or to a BRT platform would be provided for pedestrians to move safely and smoothly.

10.1.3 Land Use Policy of Sub-Centres

Sub-Centres will function as a second-level central business district in the future. To encourage business and commercial functions in sub-centres and contribute to the target of "Sustainable Urban Structure", development of sub-centres harmonising with public transportation is important. The following land use policy for sub-centres plays a significant role in forming the second-level central business district.

(1) Current Situation

The areas within 10km from CBD such as Tazara, Ubungo, Mwenge, Morocco, have important junctions/cross sections in road network as well as public transport. Tazara and Ubungo have access to railways. Morocco and Ubungo has access to BRT. These areas have potential to be developed as sub-centres by utilizing the access to existing and future public transport.

(2) Issues

Although Tazara, Ubungo, Mwenge, Morocco have locational advantages of proximity with CBD, agglomeration of urban functions is not so attractive that second-level central business district cannot be formed. Public transport facilities such as bus terminals are not convenient for users, for example, railway stations and BRT stations are separated and seamless transfer between the two modes is not provided.

(3) Contribution of Sub-Centres to Targets of UTMP Vision

Future land use of sub-centre shall contribute to attaining the targets and vision of UTMP. Sub-centres shall especially play an important role in attaining the target of "Sustainable Urban Structure" by strategically locating business and commerce functions as well as residential functions.

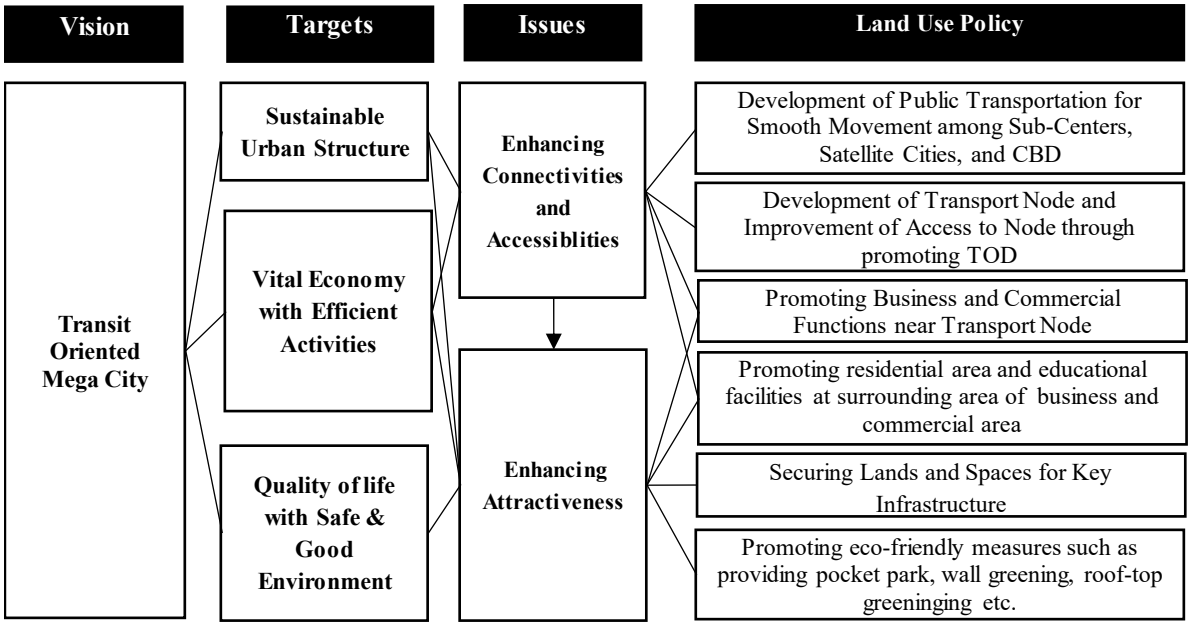
Enhancing attractiveness of sub-centres will increase the visitors and commuters to sub-centres and contribute activating business and commerce activities. This will contribute to attaining the target of "Vital Economy with Efficient Activities".

Enhancing Attractiveness around transport nodes as well as enhancing connectivity between transport nodes and buildings for business and commercial purposes is also a key in promoting TOD and encouraging modal shift from private vehicle users to public transport users. Enhancing attractiveness of sub-centres also contributes to the target of "Quality of life with Safe and Good Environment" though promoting TOD.

The target of "Society with Equal Opportunity for All" is mainly realised by operational measures of public transport mode. Land use policy here focuses on contribution to other three targets.

(4) Land Use Policy

To address the issues and to attain the vision, the following policies should be set for land use for sub-centres. Figure 10.1.6 shows relationship among vision, targets, issues, and land use policy in sub-centres.



Source: JST

Figure 10.1.6 Relationship among Vision, Targets, Issues, and Land Use Policy in Sub-Centres

a) Developing Public Transportation for Smooth Movement among Sub-centres, Satellite Cities, and CBD

- By taking locational advantages of sub-centres located between CBD and satellite cities, development of public transportation connecting to sub-centres plays an important role for smooth movement among CBD, satellite cities, and sub-centres and for public transport users to experience comfort.

b) Development of Transport Node and Improvement of Access to the Node

- To shape convenient sub-centres, development of transport nodes such as BRT and train stations and realising seamless connection among transportation modes would be promoted. This is also one of the important measures to encourage modal shift from private vehicles to public transportation. Connection to business and commercial buildings from transport nodes shall be enhanced.
- To provide safe and comfortable walking environment for pedestrians such as sidewalks at transport node and along the roads in the surrounding area of the transport node.

c) Promoting Business and Commercial Functions near Transport Node

- To shape the convenient sub-centres, commercial and business functions in CBD are dispersed to the sub-centres. Commercial and business functions shall be located near transport nodes such as MRT stations and BRT terminals, etc., to enhance accessibility for commuters and visitors.

d) Promoting residential area and educational facilities at surrounding area of business and commercial area

- To avoid crossing flow lines of pedestrians between residents and visitors, residential areas and educational facilities shall be at surrounding areas of business and commercial facilities.

e) Securing Lands and Spaces of Key Urban Functions as Satellite Cities

- To function as sub-centres and to build convenient urban areas, key urban functions such as commercial and business, educational, administrative, entertainment, etc. will be agglomerated at the sub-centres. This agglomeration will contribute to dispersing urban functions of CBD.

f) Promoting eco-friendly measures such as pocket parks, wall greening, and roof top greening

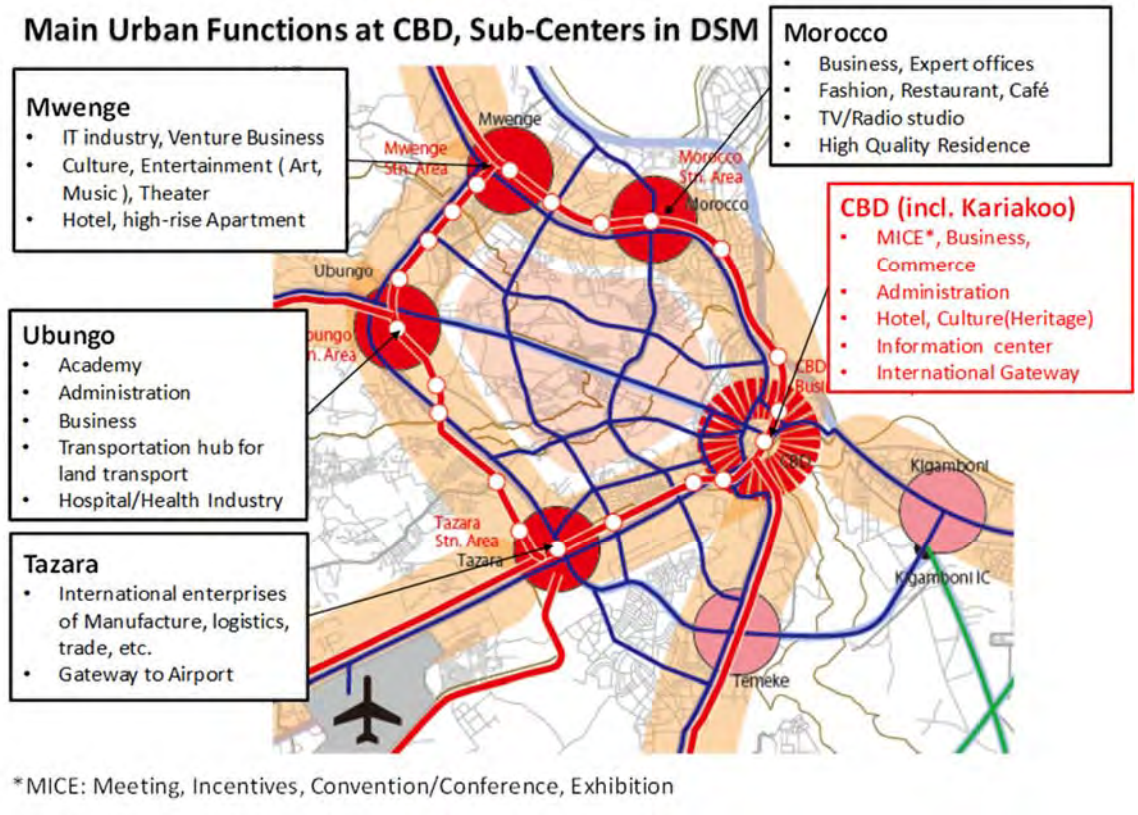
- New buildings shall be designed with eco-friendly measures by promoting pocket parks, wall and roof top greening to absorb carbon dioxide and clean air, etc.

In terms of urban functions of sub-centres, diversification among the sub-centres in urban functions can contribute to a more dispersed urban structure and utilise existing locational advantages and resources in sub-centre development. Table 10.1.2 shows the current setting and main urban functions in the future. The main urban functions in future sub-centres have been considered based on the existing conditions from the viewpoints of taking the existing locational advantages of each area. Figure 10.1.7 shows the expected urban functions at each sub-centre and CBD.

Table 10.1.2 Details of Current Setting and Main Urban Function in Future for CBD and Sub-centres

	Current Setting	Main Urban Function in Future
CBD	• Business and Commerce • Administration • Hotels • Cultural Heritage • Gateway to overseas via Zanzibar	• MICE, Business, Commerce • Administration • Hotel, Culture (Heritage) • Information Centre • International Gateway
TAZARA	• Junction of TRL (Ubungo line and Pugu line) • Terminal of TAZARA • Proximity to industrial area • Along Nyerere Rd. connecting to International Airport	• International enterprises of Manufacture, logistics, trade, etc. • Gateway to Airport
Ubungo	• Proximity of Campus of Univ. of Dar es Salaam, Ardhi Univ. • Proximity of administrative services such as TANESCO • Terminal of TRL (Ubungo line) and BRT • Intersection of Nelson Mandela Rd. and Morogoro Rd.	• Academy • Administration • Business • Transportation hub for land transport • Hospital/Health Industry
Mwenge	• Intersection of Sam Nujoma Rd. and Bagamoyo Rd. • IT industry • Movie Theaters	• IT industry, Venture Business • Culture, Entertainment (Art, Music), Theater • Hotel, high-rise apartment
Morocco	• Proximity to Masaki area where high income level families resides • New development of housing complex and shopping centre by NHC	• Business, Expert Offices • Fashion, Restaurant, Café • TV/Radio studio • High quality residence

Source: JST



Source: JPT

Figure 10.1.7 Main Urban Functions at CBD and Sub-Centres

10.1.4 Land Use Policy of Satellite Cities

Satellite Cities will have urban functions dispersed from CBD and be sustained by sharing urban functions with sub-centres and CBD. To encourage business and commercial functions as well as residential functions in satellite cities and contribute to the target of "Sustainable Urban Structure" of Vision of UTMP, development of satellite cities harmonising with public transportation and surrounding natural environment is important. The following land use policy plays a significant role to guide the development of the satellite cities for forming "Sustainable Urban Structure".

(1) Current Situation

Urban sprawl is on-going in suburban areas especially beyond 10km radius from CBD and stretching to City boundary. The sprawl has used up open spaces and urged inefficiency in terms of infrastructure development. Road density in suburban areas is low, but vehicle owners are increasing as their incomes go up. People are also forced to take long distance and time for commuting to CBD.

(2) Issues

Mitigation of urban sprawl is a key issue for the suburban areas. Urban sprawl accelerates disorderly expansion of urban areas, and it leads to insufficient and inefficient development of infrastructure. It also causes environmental deterioration and vulnerability to natural disasters. Currently, road density in suburban areas is low, but residential developments, which are mainly for medium income level individuals who can purchase vehicles, are progressing. To mitigate and prevent the urban sprawl, dispersing urban functions from CBD to suburban areas by developing satellite cities as new urban areas is key in shaping DSM as specified in the vision. Satellite cities are the smaller metropolitan

areas which are located somewhat near to, but are mostly independent of larger metropolitan areas.

(3) Contribution of Satellite Cities to Targets of UTMP Vision

Future land use of satellite cities shall play an important role in attaining the target of "Sustainable Urban Structure" by strategically locating business and commerce functions as well as residential function to be main urban cores of the urban structure.

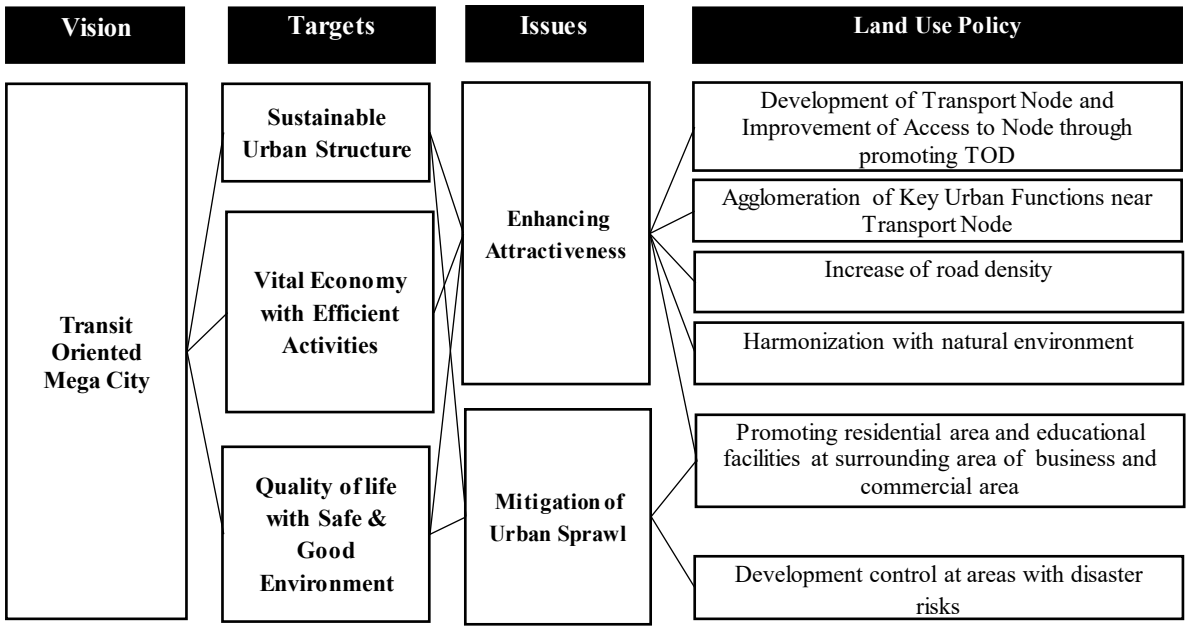
Realizing proximity between working place and residential place will contribute to attaining the target of "Quality of Life with Safe & Good Environment". It will reduce the trip distance for those commuting from houses by creating jobs at the centre of the satellite cities.

Enhancing attractiveness around transport nodes as well as enhancing connectivity between transport nodes and buildings for business and commercial or park and ride system is also key in promoting TOD and encouraging modal shift from private vehicle users to public transport users, who commute from the satellite cities to sub-centres and CBD.

The target of "Society with Equal Opportunity for All" is mainly realised by operational measures of public transport mode. Land use policy here focuses on contribution to other three targets.

(4) Land Use Policy

To address the issues and to shape DSM as the vision specifies, the following policies should be set for land use in New Urban Areas. Figure 10.1.8 shows relationship among vision, viewpoints, and land use policy in New Urban Areas. Satellite cities, which are self-reliant cities without minimum dependent on CBD, will be developed as New Urban Areas. To have dispersed urban functions from CBD is the essential part of the land use policy.



Source: JST

Figure 10.1.8 Relationship among Vision, Targets, and Land Use Policy in New Urban Areas

a) Development of Transport Node and Improvement of Access to the Node

- To shape convenient new urban areas, development of transport nodes such as BRT and train stations and realising seamless connection among transportation modes will be promoted. This is

also one of the important measures to encourage modal shift from private vehicle to public transportation. Providing park and ride system is also to be developed at the transport nodes, if spaces are available.

- Access to the transport nodes from residential areas will be improved by providing public transportation and improving existing roads in order to build convenient urban areas.

  Safe spaces for the pedestrian, such as sidewalks at transport nodes and along the roads in the surrounding areas of transport nodes shall be improved in order to provide safe environment.

b) Agglomeration of Key Urban Functions near Transport Node

- To function as satellite cities of DSM and to build convenient urban areas, key urban functions such as residential, commercial and business, educational, administrative, entertainment, etc., will be agglomerated near transport nodes such as MRT stations and BRT terminals. This agglomeration will contribute to dispersing urban functions of CBD.

c) Increase of Road Density

- New roads with sidewalks in the satellite cities will be developed to mitigate traffic congestion, realise smooth traffic in the cities, and provide comfortable space for pedestrians.

d) Harmonization with Natural Environment

- By controlling development to be mentioned in f), natural environment in flood-prone areas will be protected.
- Vegetation will be also maintained as much as possible when lands are developed.

e) Promoting residential area and educational facilities at surrounding area of business and commercial area

- To avoid crossing flow lines of pedestrians between residents and visitors, residential areas and educational facilities shall be located at surrounding areas of business and commercial facilities.
- By taking locational advantages of suburban areas, low to medium density residential areas will be developed to provide comfortable environment at surrounding areas of business and commercial facilities.

f) Development Control at Areas with Disaster Risks

- Development will be controlled at areas with steep slope having risks of land slide. Slope protection measures will also be taken to prevent land slide. These will contribute to enhancing resilience.
- Development at flood-prone areas will be controlled to protect human lives and properties.

10.1.5 Next Step for Future Implementation of Policy

To implement the policies mentioned above, it is critical that DSM Master Plan be finalized or newly developed through integrating these policies. Plus, the master plan needs to be authorized by Minister of Land, Housing and Human Settlements Development for all concerned stakeholders of urban development to follow the master plan. DCC is expected to play the role of a planning authority of the master plan and take initiatives of the planning with the support by MOLLHSD and PO-RALG.

MOLLHSD is also requested to formulate measures for both development control and development promotion. Municipalities shall prepare detail planning for development of sub-centres and satellite cities by encouraging involvement by private sectors. NHC shall support municipalities to elaborate the detail plan for implementation as NHC has done in Kawe Satellite City and Morocco square. Institution for implementation will be formed as mentioned in sub-chapter 11.2.2.

10.2 Road Plan

10.2.1 Flow of Road Planning

For road planning, following procedures were taken:

(1) Identification of traffic problems
(2) Analysis of the problems and factors (refer to Fig. 5.1.32)
(3) Necessity of road planning and study of measures
(4) Policy formulation with consideration to other sectors

10.2.2 Necessity of Road Planning

As mentioned in Chapter 5, there are negative factors that result in traffic problems as shown in Figure 10.2.1.

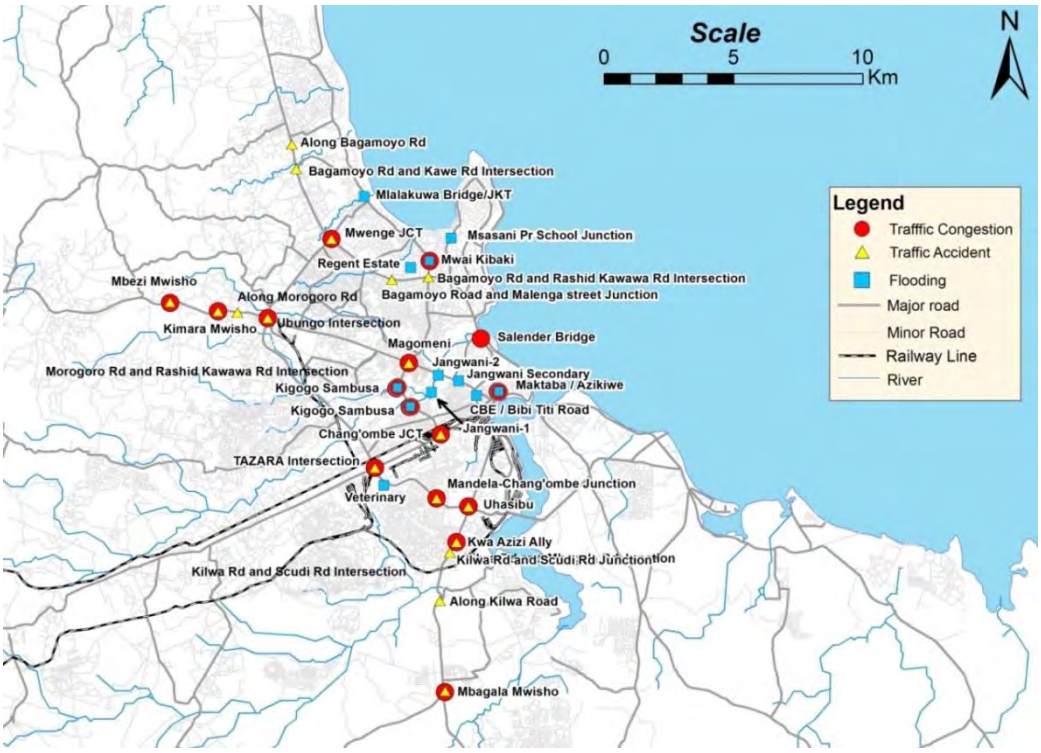


Figure 10.2.1 Location Map Showing Traffic Problems

10.2.3 Technical Approach to the Negative Factors

Technical approach by giving five kinds of measures is shown below.

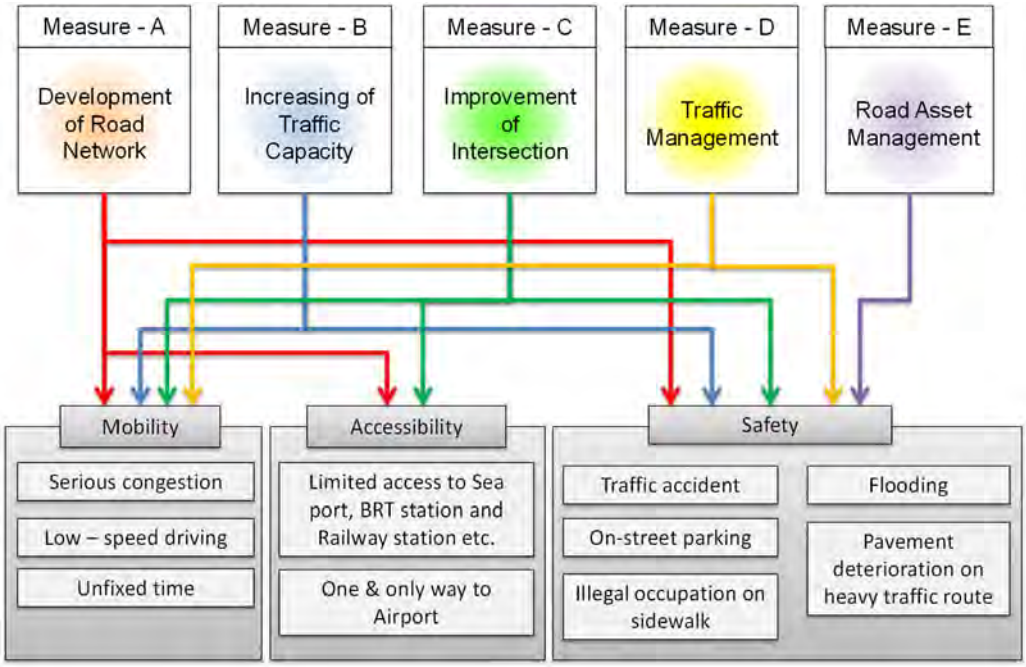


Figure 10.2.2 Technical Approach to the Negative Factors

It is made to remove each negative factor identified by analysing problems. In measure-A, development of road network would be the solution to the mobility, accessibility and safety issues. Measure-B, increasing of traffic capacity is for mobility and safety. Measure-C, improvement of intersection is for mobility, accessibility, and safety. Measure-D, traffic management is for mobility and safety. Measure-E, road asset management is for safety.

Each measure has components that work on an objective negative factor. Each component is summarized in Table 10.2.1.

Table 10.2.1 Components of Measures

Measure	Component	Description
Measure-A	A-1	Development of Ring Road and Bypass
	A-2	Completion of the "Missing Links"
	A-3	Development of Regional / Feeder Road
	A-4	Multi-access to Airport
Measure-B	B-1	Upgrading or Widening of Existing Road (For current problem)
	B-2	Determination of Road Classification (For future plan)
	B-3	Determination of Access Control (For future plan)
Measure-C	C-1	Grade Separation
	C-2	Countermeasures for At-grade Intersection
Measure-D	D-1	Introduction of Traffic Regulation
	D-2	Introduction of Intelligent Transport System (ITS)
	D-3	Promotion of Public Transportation
Measure-E	E-1	Maintenance / Upgrading of Existing Drainage
	E-2	Drainage Plan
	E-3	Strengthening of Pavement

10.2.4 Policy on Road Plan

(1) Basic Policy

Basic policy on road plan is determined in the following matters.

a) Road plan is to be integrated and harmonised with land use plan, public transport plan and traffic management plan.

b) Road network is to be enhanced for rapid traffic demand in the future.

c) Missing links are to be completed and road density is to be increased for accessibility improvement.

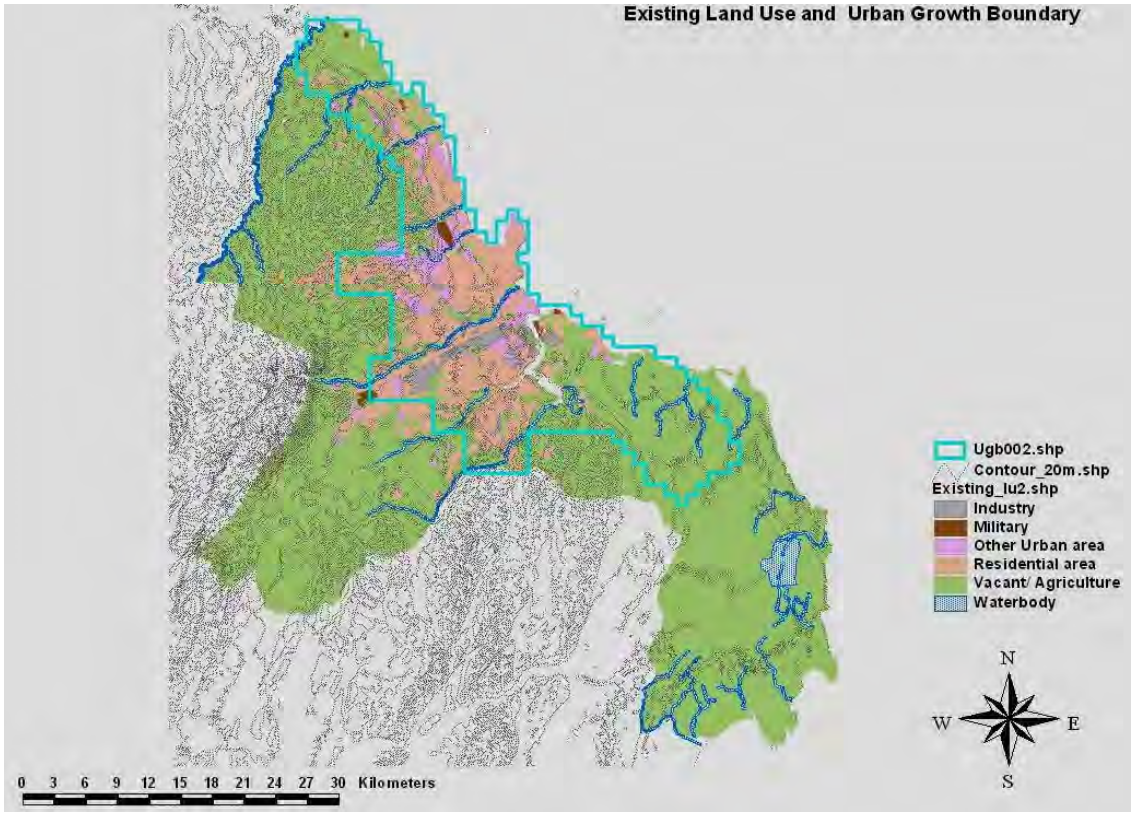
d) Measures for traffic safety are to be taken to reduce traffic accidents and flooding risks by introducing ITS and intersection improvement.

e) The staging plan is to be set up according to the practical implementation schedule of other sectors.

(2) Positioning of Expressway

a) Concept of Expressway Plan in previous JICA Master Plan 2008

Concept of Expressway Plan was based on connecting the road network with in urban growth boundary (UGB) in Figure 10.2.3, where it was introduced as the border line to avoid disordered urban sprawl and expansion of unplanned settlements to the peripheral. The UGB designates a limit of urbanisation for the next 20 years. The inside of the UGB is a priority area in implementation of intensive urban development to accommodate future increasing population. Outside of the UGB are rather rural areas that emphasise protection of agriculture and natural forests. A long-term investment of infrastructure should concentrate on inside of the UGB.



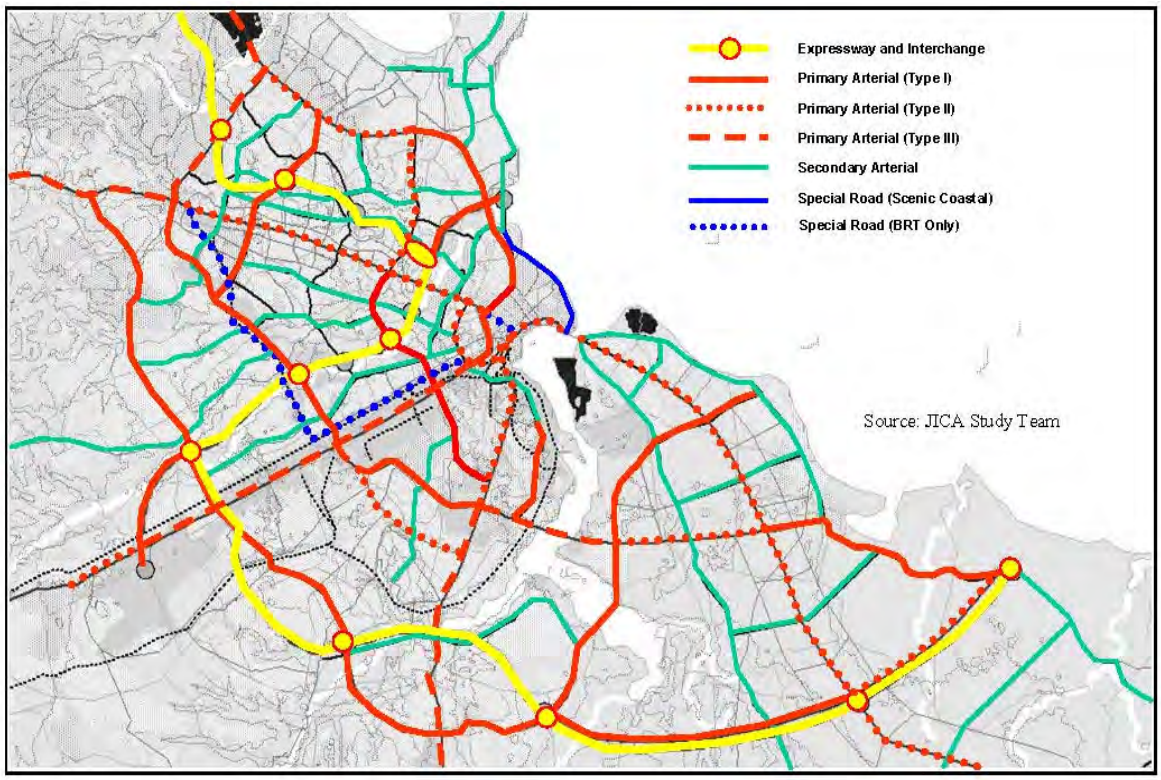
Source: Dar es Salaam Transport Policy and System Development Master Plan Final Report June 2008

Figure 10.2.3 Proposed Urban Growth Boundary (UGB) 2008

b) Expressway Plan in previous JICA Master Plan 2008

The Expressway Plan was formulated in the previous JICA Master Plan 2008 as shown in Figure 10.2.4 The expressway runs in parallel with the Morogoro Road in the future urban business/commercial axis, hence providing motorists direct access to their destinations along the BRT

Phase 1 corridor. This expressway alignment will contribute to the urban regeneration of the BRT Phase 1 corridor as well.



Source: Dar es Salaam Transport Policy and System Development Master Plan Final Report June 2008

Figure 10.2.4 Expressway Plan in the Previous JICA Master Plan 2008

c) Situation Change in Planning of Expressway

The Government of Tanzania has identified the need to upgrade the Dar es Salaam – Chalinze road to Expressway Standard Toll Road in line with the Government's Investment Plan and Five Years Development Programme in June 2010. Based on this, a feasibility study was commenced in 2015 and completed in December 2016. Refer to Chapter 3 regarding the road alignment.

d) Expressway Plan in This Master Plan 2018

In this Master Plan, the Expressway Plan mentioned above should be respected as the plan was authorized by the Government of Tanzania. The expressway will contribute to long-distance passenger traffic and bulk transport traffic from DSM to Dodoma via Chalinze and Morogoro.

Considering the future traffic demand analysis result, the expressway will play an important role to mitigate traffic congestion in DSM. Thus, stepwise investment for the expressway development is necessary.

Although the number of lanes is six (6) in the authorized expressway plan, four lanes should be served initially and two lanes will be added depending on the traffic increase.

In this Master Plan 2018, the expressway can be divided into two sections, namely, intercity section that is located in the direction of southern area DSM and a part of the Outer Ring Road, and the other section. The expressway in the intercity section is expected to be toll-free. Hereinafter, the intercity expressway shall be called as the Arterial Road or Outer Ring Road.

(3) Road Hierarchy

In planning of roads in revising the Master Plan, clarification of road hierarchy is essential in identifying the function of the road. Although there exists a road act and a highway act in Tanzania, details of the expressway or the ring road which is positioned higher than trunk roads is not defined. In the Master Plan, the road hierarchy is proposed so that all roads can be covered as described in Figure 10.2.5. In the road plan, 1st and 2nd roads are collectively called arterial roads. Similarly, 3rd and 4th are called collector roads.

Hierarchy	Road Class	Function required
1st	● Expressway	● High travel speed ● Nonoccurrence of flooding ● Full or partial access control
2nd	● Arterial road (Ring Road, Trunk Road and BRT)	● Relatively high travel speed ● Nonoccurrence of flooding ● Partial access control ● Never occurring flooding
3rd	● Regional road	● Partial access control
4th	● Collector road ● Feeder road ● Community road	● Unrestricted access control

Matrix of Intersection Form

	1st	2nd	3rd	4th
1st	GS	GS	GS	GS
2nd	GS	GS	GS / AG	AG
3rd	GS	GS / AG	AG	AG
4th	GS	AG	AG	AG

Figure 10.2.5 Proposed Road Hierarchy

(4) Typical Cross Section

Proposed typical cross sections by the proposed road hierarchy are shown in Figure 10.2.6. All elements are based on the existing plan and Tanzania Road Design Standard.

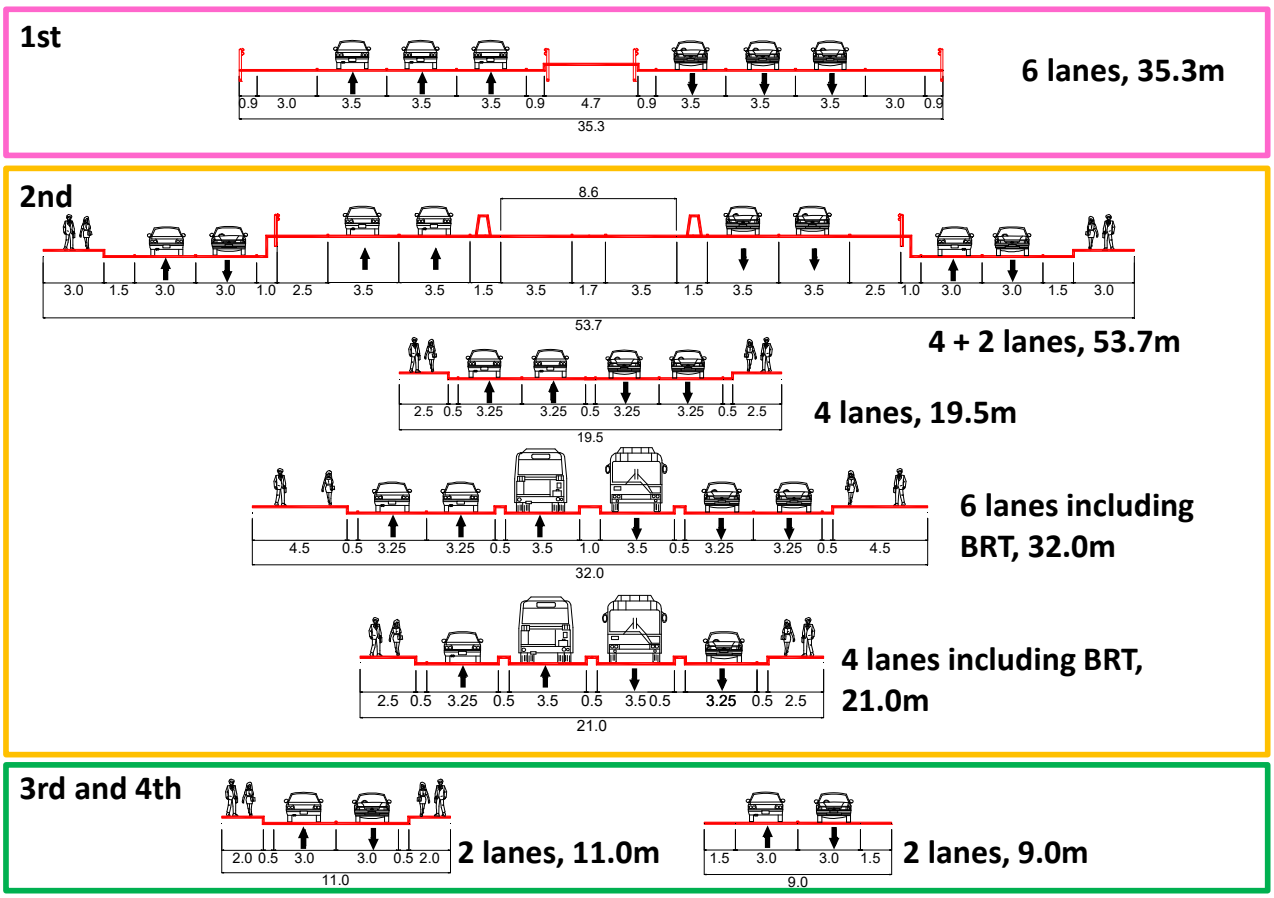


Figure 10.2.6 Proposed Typical Cross Section by Road Hierarchy

(5) Technical Approach

a) Arterial Road

All planned arterial roads should be of the 1st or 2nd class in the road hierarchy so that high services can be provided more than other roads.

In order to strengthen and improve the future road network and traffic capacity, the ring road development and missing link completion as described in Figure 10.2.7 are proposed.

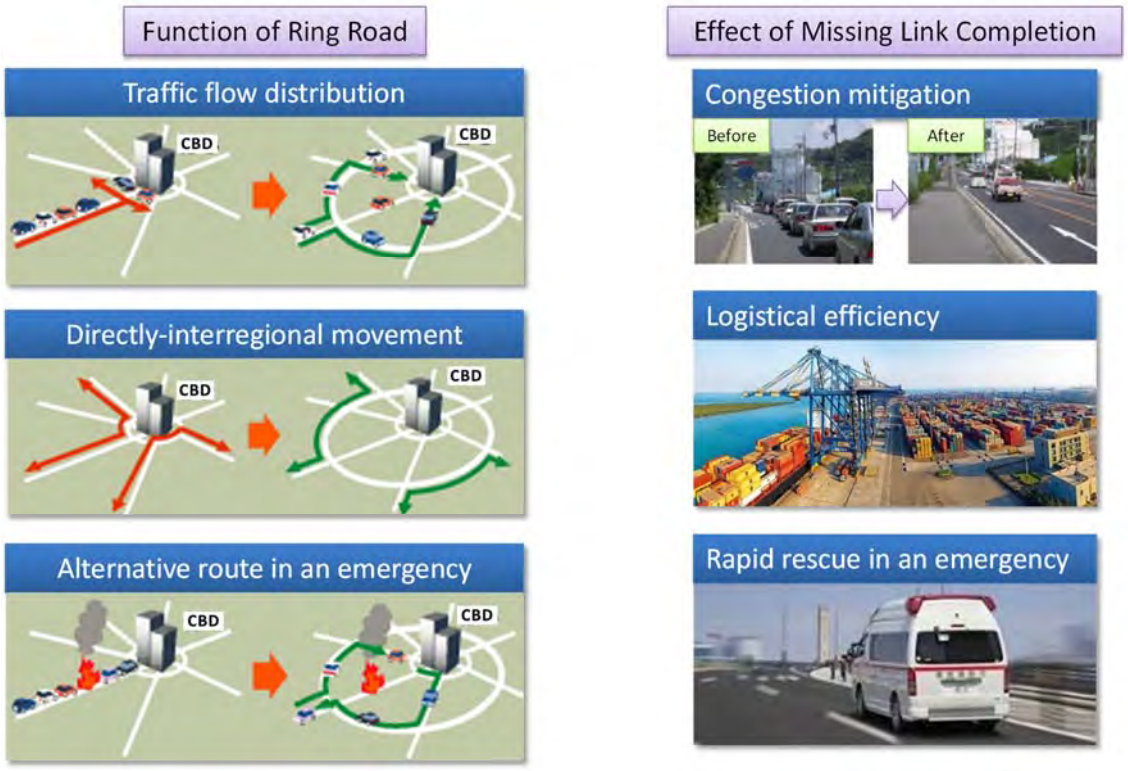


Figure 10.2.7 Function and Effect of Ring Road

b) Collector Road

i. Definition

Definition of the collector road is explained in Figure 10.2.8, which is a two-lane paved road. The function of the collector road is to connect communities and to distribute traffic.

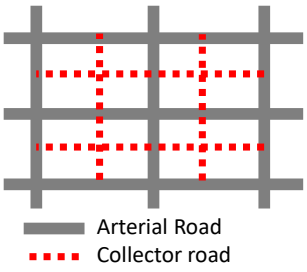


Figure 10.2.8 Definition of Collector Road

Photo - Definition of Collector Road

ii. Minimum Requirement

To perform the functions mentioned above, collector roads should meet following minimum requirements:

- 2-lane carriageway
- Paved road
- Maximum grade is 10%

iii. Policy on the Collector Road Plan

Ground vertical slope in the river crossing direction is generally more severe than that of river flow direction. Through the site survey, it was fund that slopes of most sections are under 10%, as shown in Figure 10.2.9.

This means that existing roads can be geometrically utilized for the collector roads and it will be the most economical option because land acquisition for new road construction will be minimised.

Therefore, the existing roads should be respected as the collector road as much as possible.

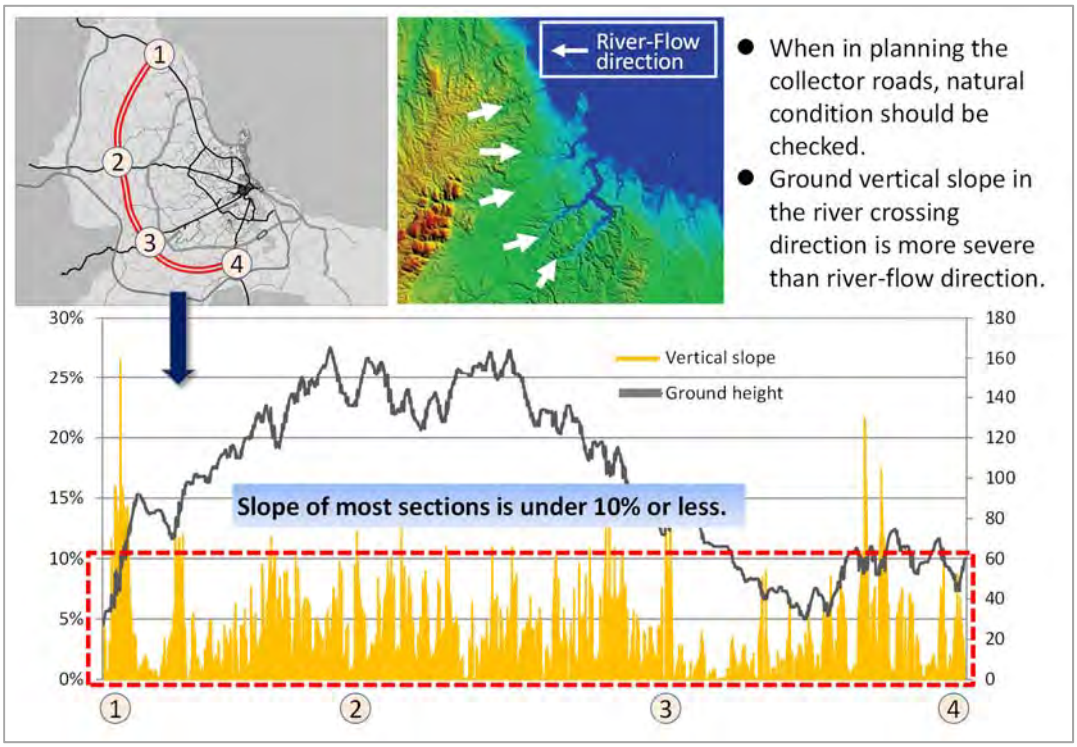
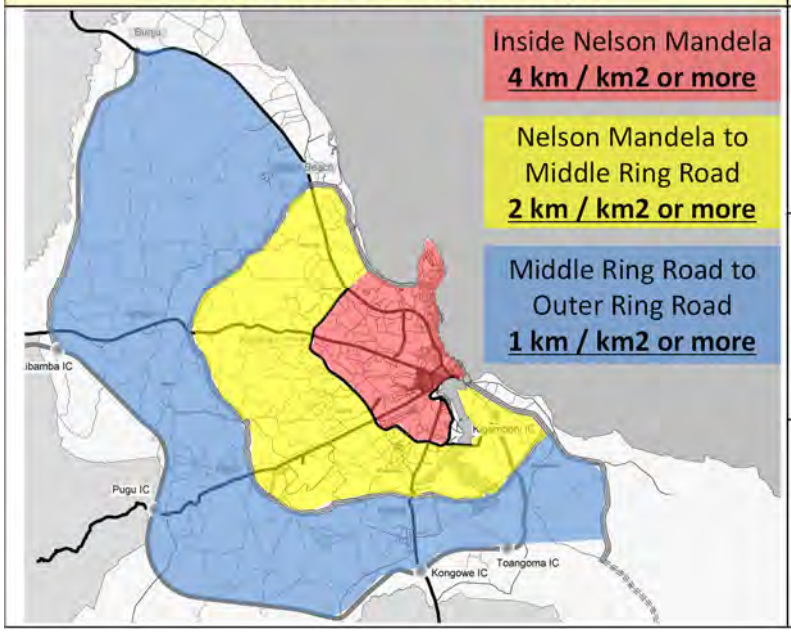
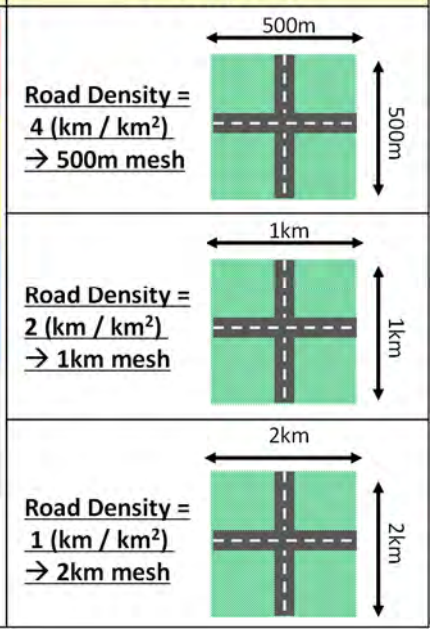


Figure 10.2.9 Check Result of Ground Vertical Slope

iv. Target Road Density

In planning, focusing on enhancement of the road density, the collector road network is developed to meet the targeted road density by area in Table 10.2.2. Here, this figure shows an average road density to be aimed at which is calculated as a ratio of road length to area of inhabitable land, since there are some wards which have topographically characteristic areas depending on the location.

Table 10.2.2 Target Road Density by Area

Target Road Density (Average)	Description
	

c) Intersection Improvement

Prioritization of intersection improvement should be made with consideration for 3 factors, which are traffic congestion, traffic accidents and flooding risks. By grouping the target intersections as illustrated in Figure 10.2.10, development priority is decided.

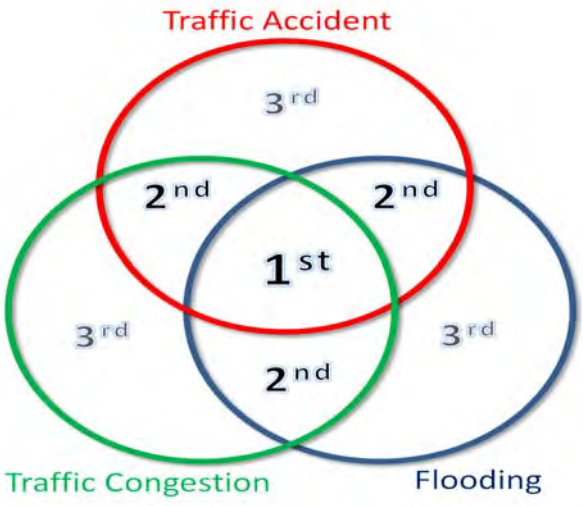


Figure 10.2.10 Image of Prioritization

(6) Authorized and Planned Project

As listed in Chapter 3, there are a lot of projects that have been authorized or planned. These are included into the road plan and mainly classified into two groups such as New Development and Upgrading / Improvement of Existing Road in Table 10.2.3 and Figure 10.2.11 to Figure 10.2.13.

Table 10.2.3 Authorized and Planned Project to be Included

Project Type	Facility Type	Project
New Development	Road / Bridge	DSM - Chalinze Expressway (144km)
		DSM Outer Ring Road (34km)
		New Selander Bridge
	BRT	Phase-2 to Phase-6
Upgrading / Improvement of Existing Road	Road / Bridge	New Bagamoyo Road 2
		Strengthening and Widening of Mandela Road
		Strengthening / Widening of Nyerere Road
		Upgrading of Tegeta - Bagamoyo Road
		Widening of Bandari Road and Upgrading of Mivinjeni Road
		Widening of Gerezani Road
		Widening of Kimara - Kibaha Rd
		Widening of Mbagala Rangi Tatu - Kongowe
		Widening of Mwai Kibaki Road
		Widening of Pugu Road
		Widening of Pugu - Mbagala Rangi Tatu Rd
		DSM Metropolitan Development Project (DMDP)
	Intersection	Ali Hassan Mwinyi / Kinondoni
		Ali Hassan Mwinyi / United Nations
		Chang'ombe Fly over Construction
		Fire Station
		Magomeni
		Mandela / Uhuru
		Morocco
		Mwenge
		Tabata / Mandela
		United Nations

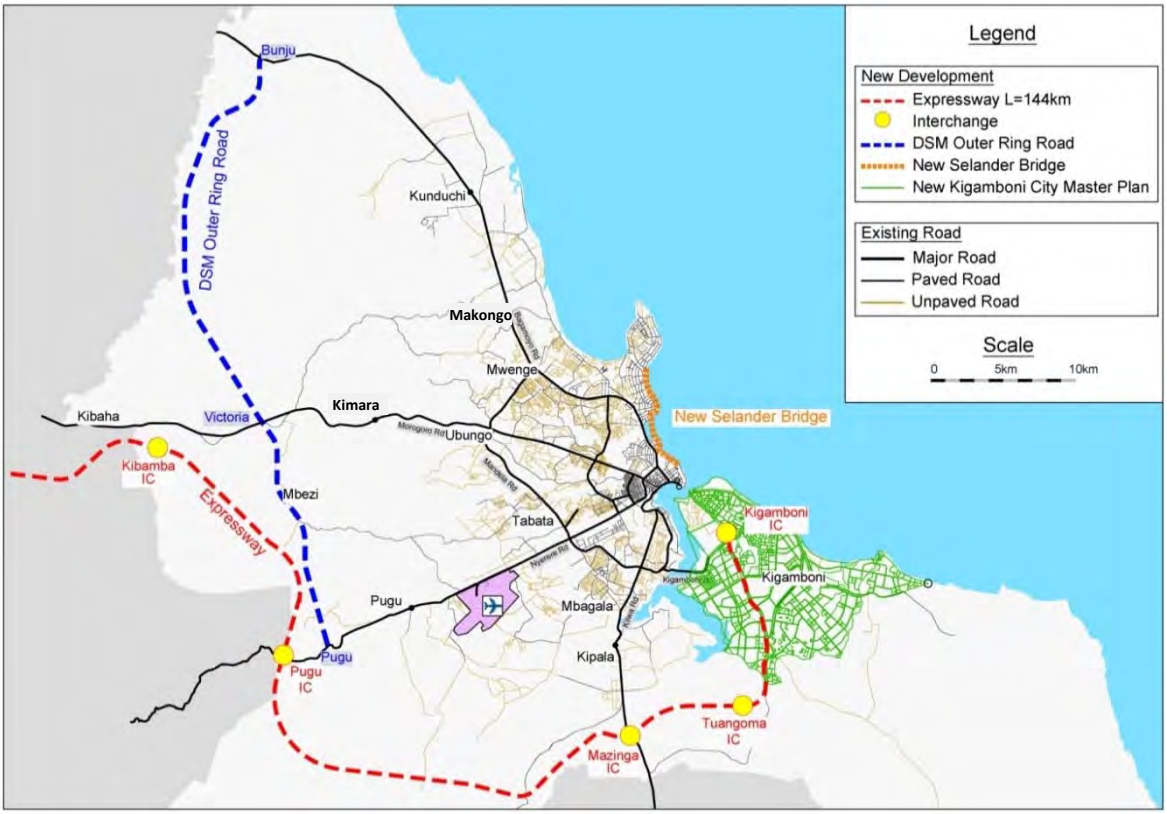


Figure 10.2.11 New Development Projects (Roads and Master Plan)

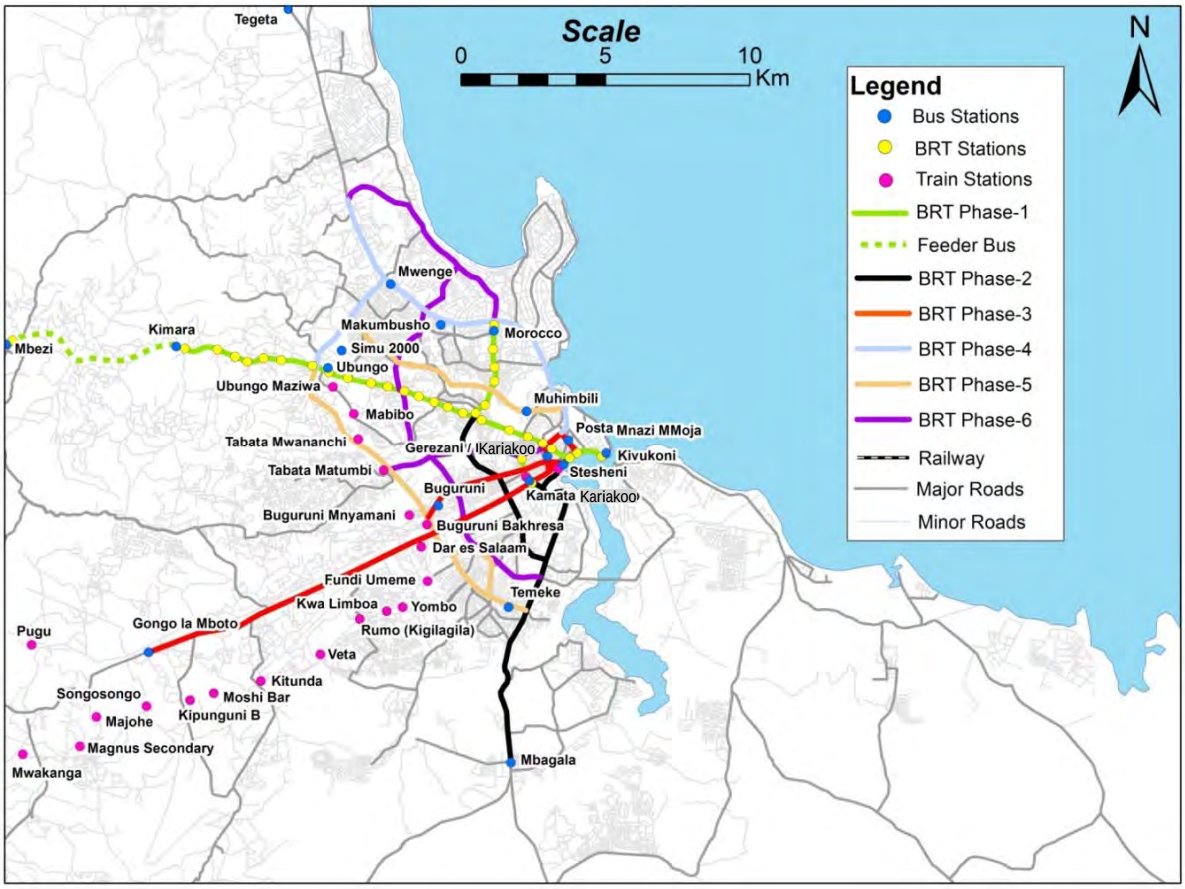


Figure 10.2.12 New Development Projects (BRT)

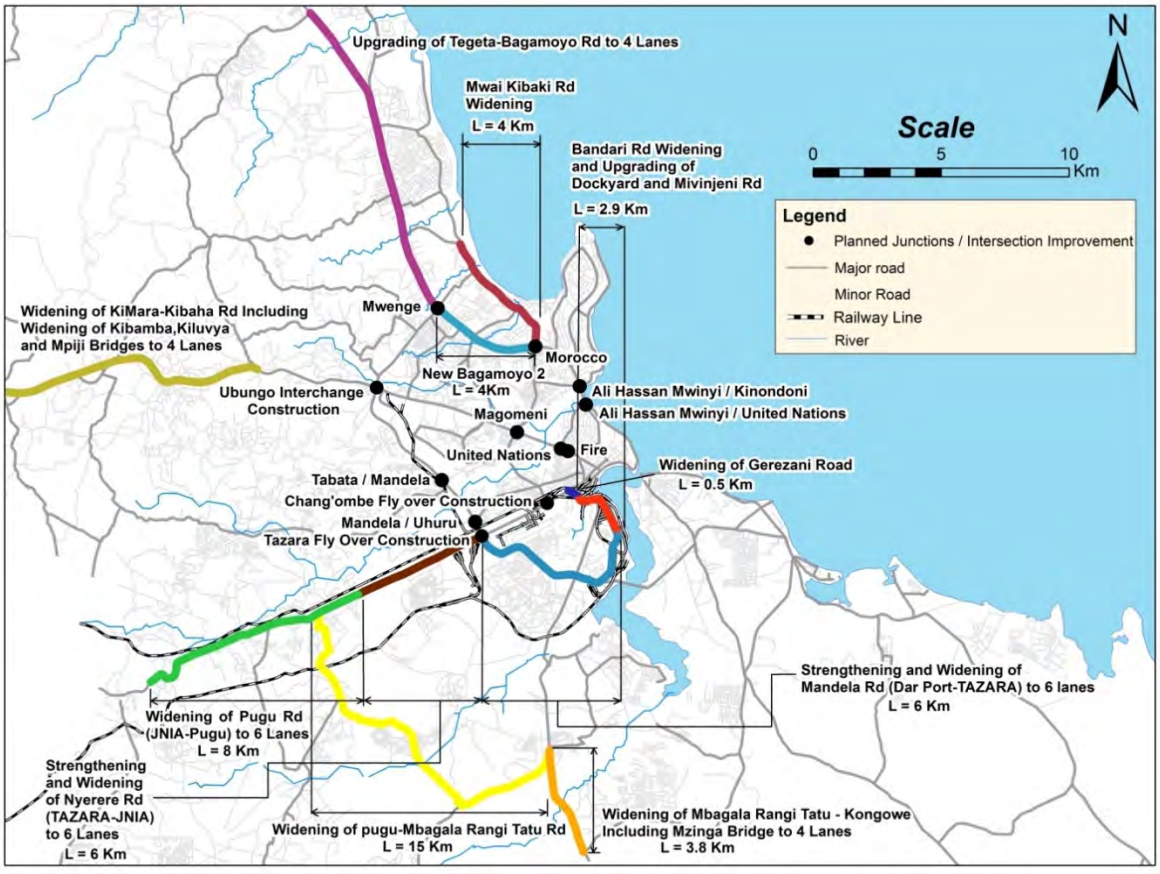


Figure 10.2.13 Upgrading / Improvement of Existing Road

10.2.5 Road Plan

10.2.5.1 Arterial Road Network

Two types of Road Network Future Scenarios depending on achievement of road improvement are suggested below:

- Case-0 : Do nothing (including existing plans)
- Case-1 : Master Plan Case
  (Arterial Road Network Development + Missing Link Completion, including existing plans)

Figure 10.2.14 to Figure 10.2.5 and Table 10.2.4 shows an outline of the new development plan. The new development plan is composed of seven projects in detail as shown in Figure 10.2.16.

Figure 10.2.14 Case-0 (Do-nothing Case)

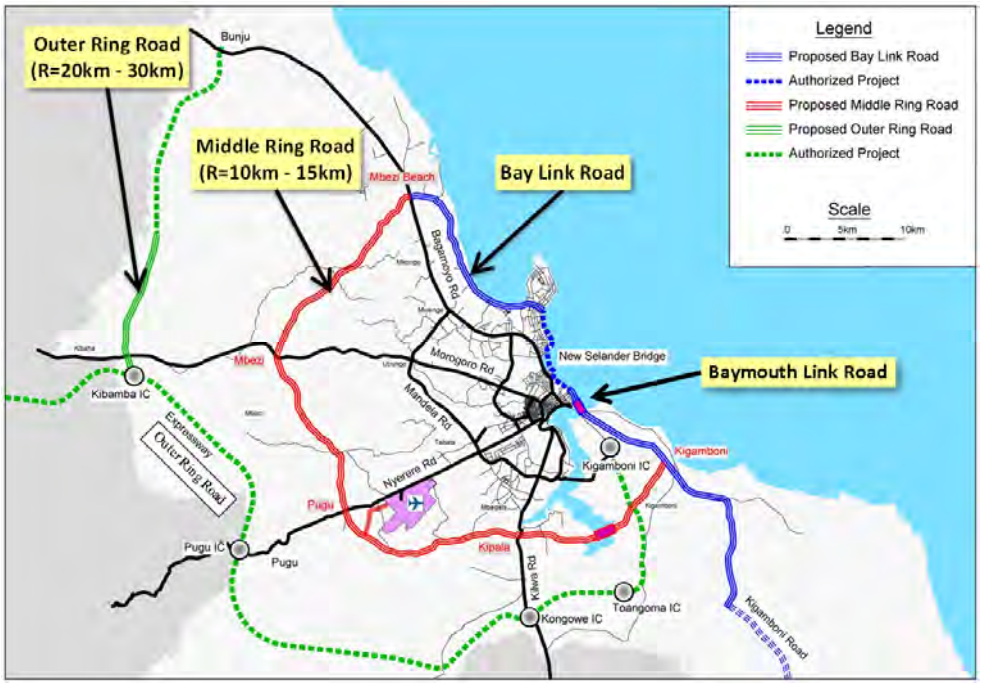
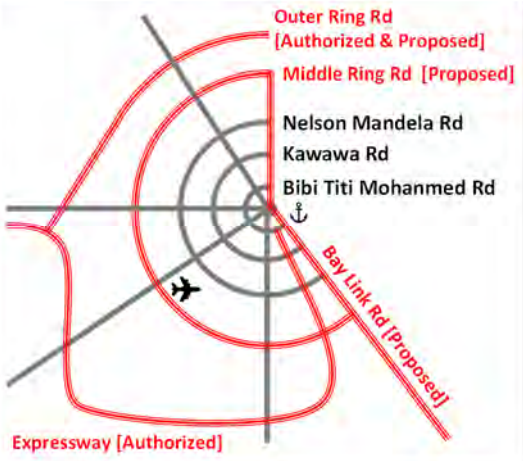


Figure 10.2.15 Case-1 (Master Plan Case)

Table 10.2.4 Summary of Future Scenario

Future Road Network Scenario

Existing Road — Authorized or Proposed

	Case-0 : Do nothing	Case-1 : Master Plan Case
Road Network Outline		
Ring Road	◆ Bibi Titi Mohammed Rd, L=3km, 4 lane ◆ Kawawa Rd, L=7km, 4 lane ◆ Nelson Mandela Rd, L=20km, 4 lane	
	—	◆ Middle Ring Road [Proposed] L=48km, 4 lane + 2 lane
	—	◆ Outer Ring Road [Authorized] L=9km, 4 lane ◆ Expressway [Authorized] L=55 km, 6 lane
Corri-dor	—	◆ Bay Link Road [Proposed] L=18 km, 4 lane

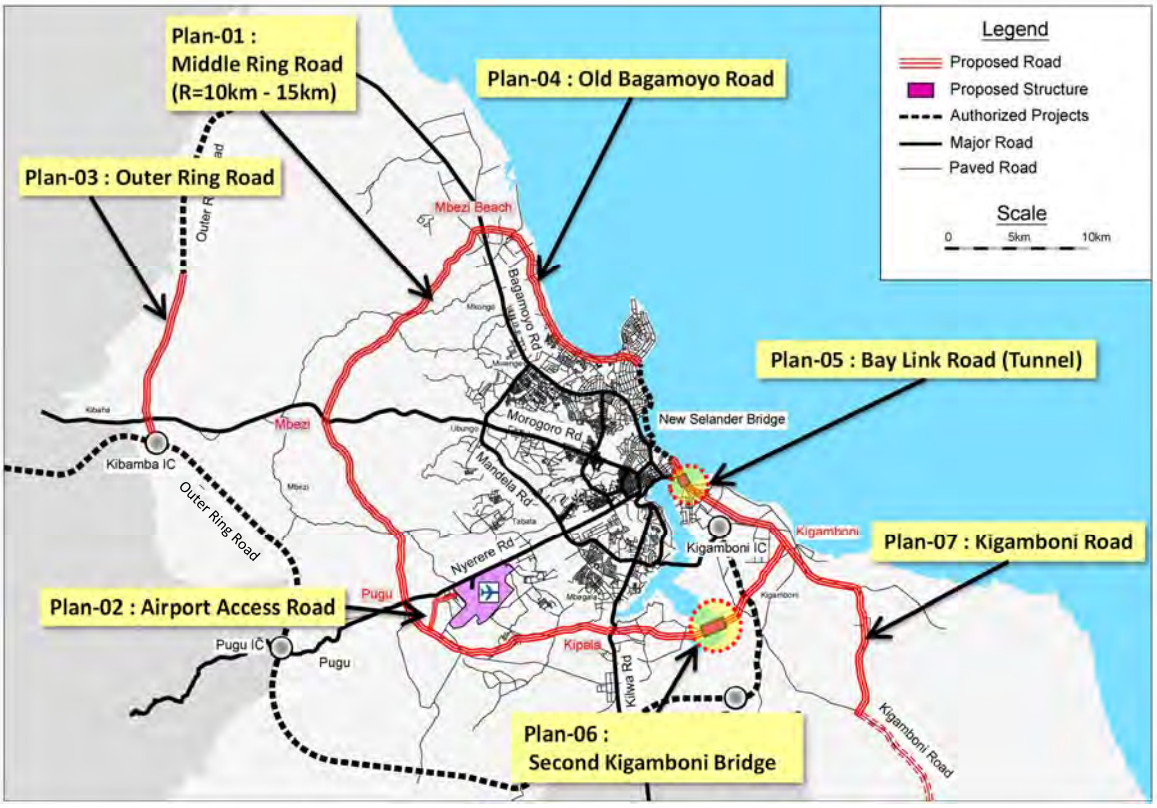


Figure 10.2.16 Detail of the New Development Plan

10.2.5.2 Future Road Network including Collector Road

Road network including collector road is shown in Figure 10.2.17.

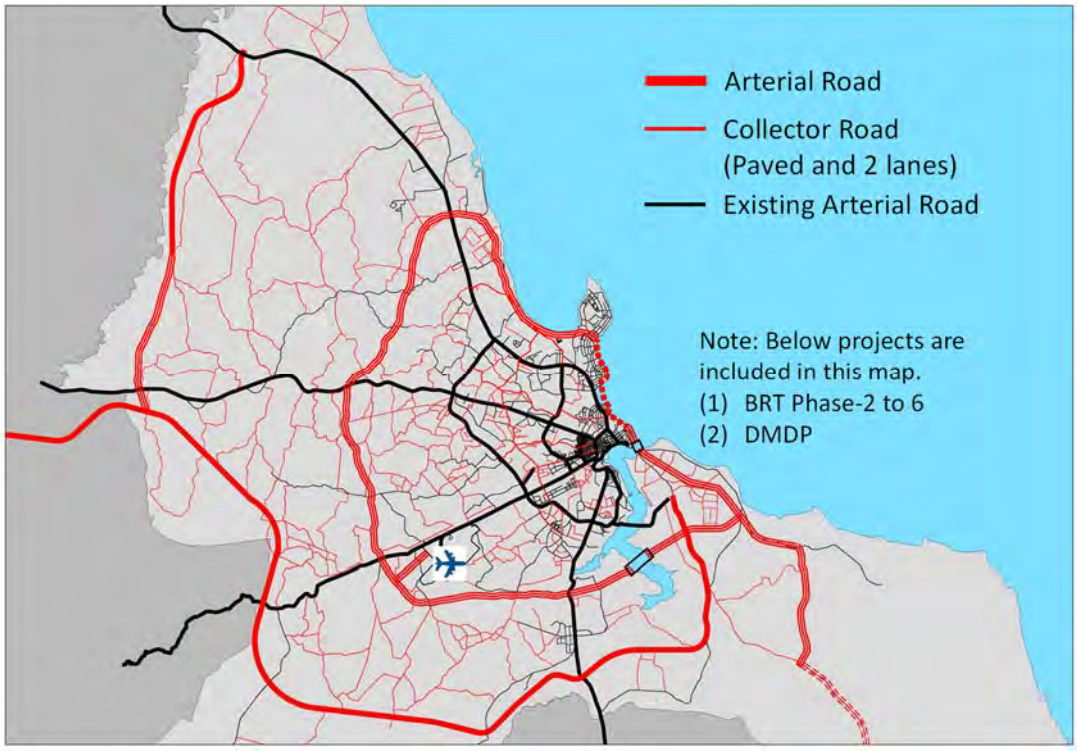


Figure 10.2.17 Road Network including Collector Road

10.2.5.3 Summary of Road Plan

(1) Road Classification by Road Hierarchy

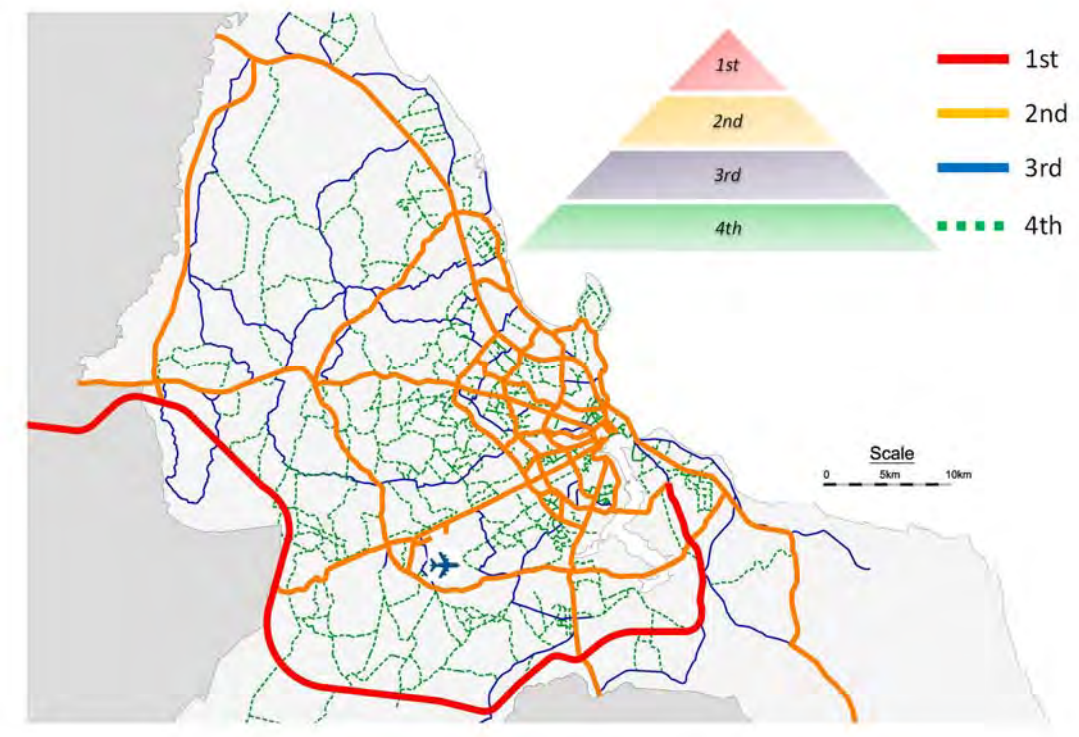


Figure 10.2.18 Road Classification by Road Hierarchy

(2) Road Network by Number of Lane

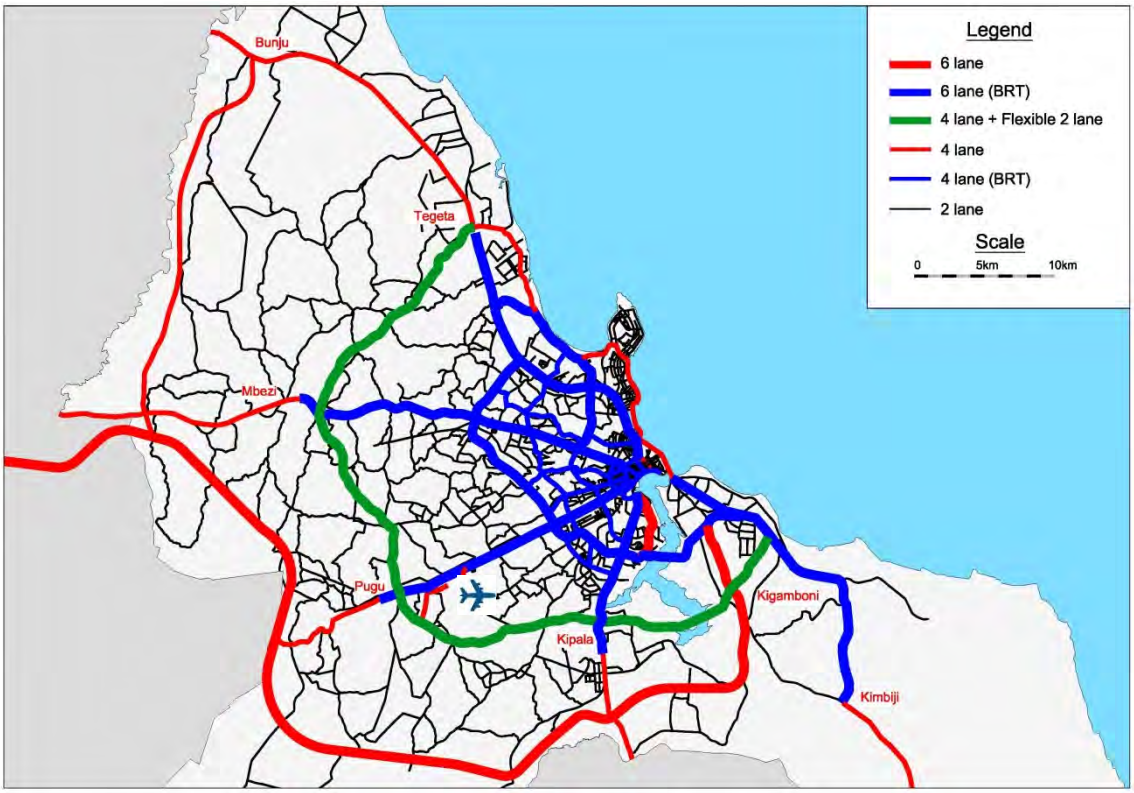


Figure 10.2.19 Road Network by Number of Lane

(2) Detailed Road Network

Detailed road network by road type classified by the Tanzania Road Geometric Design Manual (2011 Edition) is shown in Figure 10.2.20.

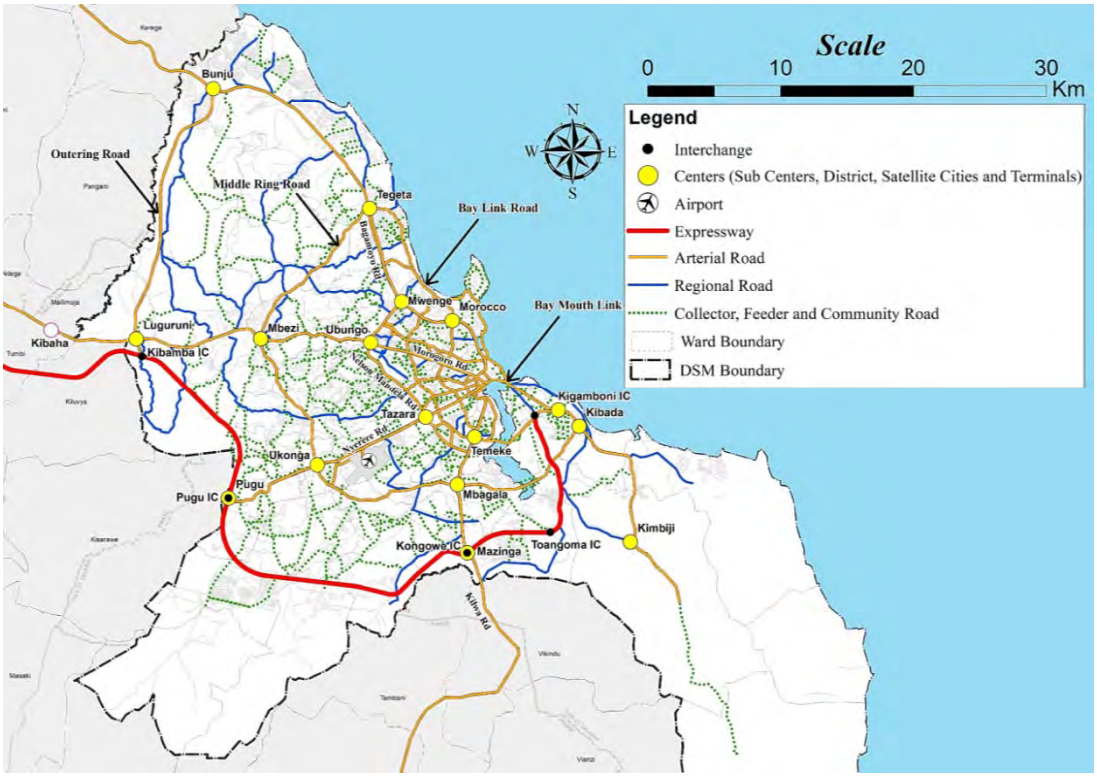


Figure 10.2.20 Detailed Road Network

(3) Road Density

Based on the policy on target road density mentioned in 10.2.4 (5), planned road density will meet the average target figure as shown in Figure 10.2.21.

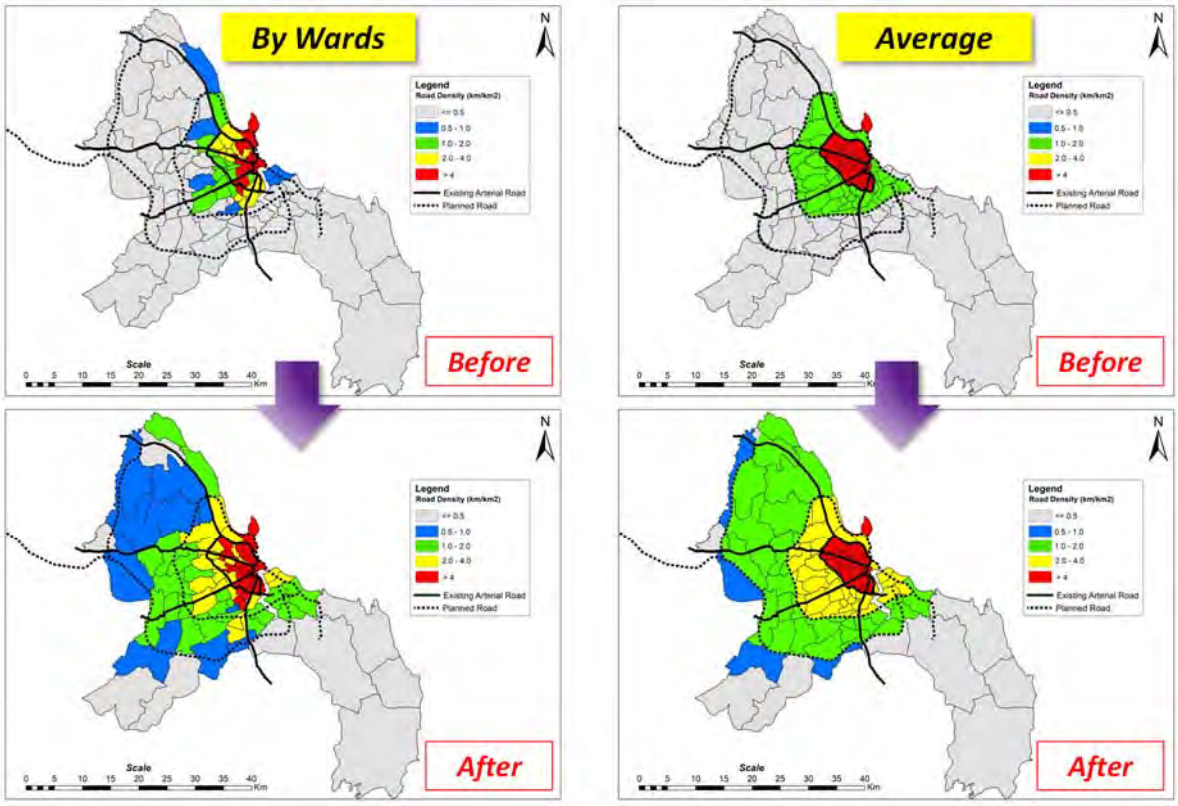


Figure 10.2.21 Road Density

(4) Quantitative Summary (Current vs. Future)

Quantitative summary under current versus future situation is summarized in Table 10.2.5.

Table 10.2.5 Quantitative Summary (Current vs. Future)

Category	Current	Future	Increase Rate
1. Total Road Length (km)	**638**	**1,566**	**2.5**
Expressway (6 lanes)	0	55	-
Arterial Road (4 lanes)	102	317	3.1
Collector Road (2 lanes)	536	1,195	2.2
2. Average Road Density in Project Area (km/km2)	**2.7**	**3.6**	**1.4**
Inside Mandela Rd.	6.1	7.1	1.2
Mandela Rd. to Middle Ring Rd.	1.5	2.6	1.7
Middle Ring Rd. to Outer Ring Rd.	0.4	1.2	3.0
3. Road Network Strength = Total length Strength Lane (No. of lane * km)	**1,479**	**3,985**	**2.7**
Expressway (6 lanes)	0	328	-
Arterial Road (4 lanes)	406	1,268	3.1
Collector Road (2 lanes)	1,073	2,390	2.2
4. Grade-separated Intersection (No. of Location)	**0**	**12**	**-**
Road crossing	0	10	-
Railway crossing	0	2	-

10.2.5.4 Detailed Study

(1) Middle Ring Road

a) Function

The Middle Ring Road is expected to be a highly advanced road by introducing ITS technology aimed at "No Congestion, No Accident and No Flooding", and to have an important role to play in the future since it connects four corridors, which are Bagamoyo Road, Morogoro Road, Nyerere Road, Kilwa Road and Bay link Road passing through the future-urbanised areas. In addition, the Middle Ring Road would function for traffic distribution and provide opportunities to access public transport for those who do not have or use private vehicles.

A proposed typical section is shown in Figure 10.2.22. The key item to be concerned with is a multi-purpose lane which can be used for purposes such as a reversible lane.

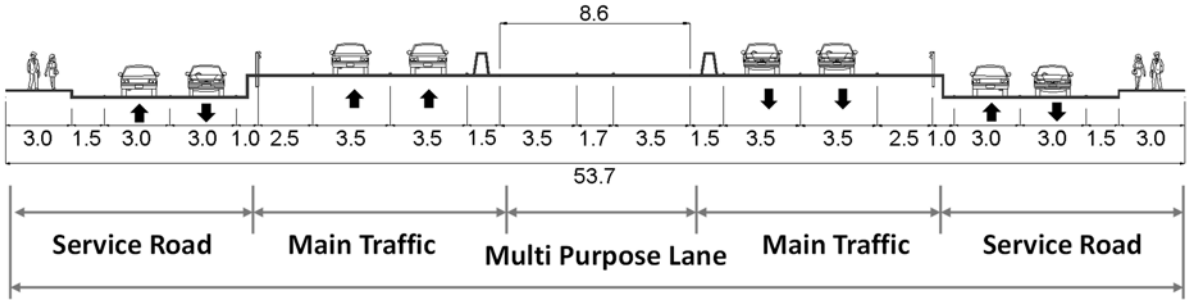


Figure 10.2.22 Proposed Typical Section

b) Road Geometry

Road geometry is summarized in Table 10.2.6. The Middle Ring Road is to be operated under full access control (Figure 10.2.23 and Figure 10.2.24) to provide high service to the drivers who are taking main traffic lane.

Table 10.2.6 Summary of Future Scenario

Item		Applied
Length		48 km
Design	Main Traffic	80km/h
Speed	Service Road	40km/h
Accessibility	Main Traffic	Full access control
	Service Road	Free access
At-grade Intersection		Nil (Grade separation only)
Min. Radius of Curvature		300m
Max. Vertical Grade		6.00%

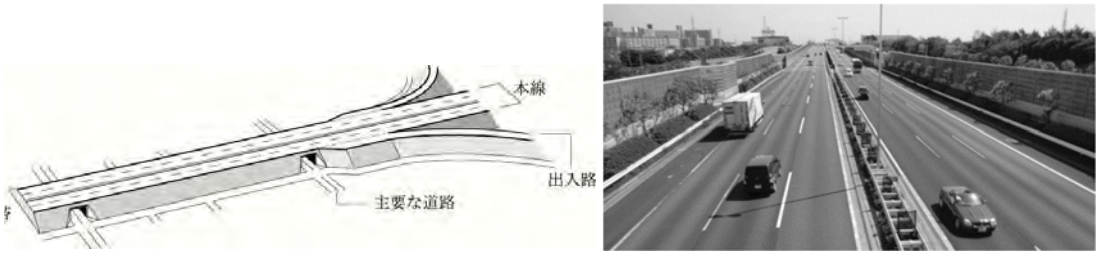


Figure 10.2.23 Image of Full Access Control

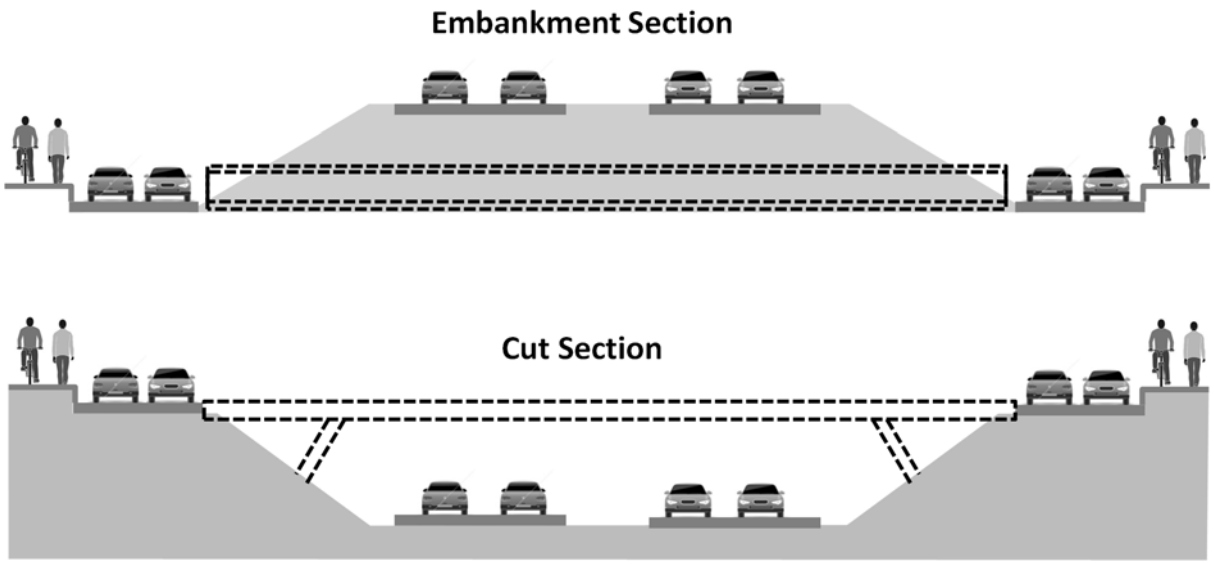


Figure 10.2.24 Image of Typical Cross Section

c) Alignment

In the case that the alignment of the existing roads is respected and utilised, construction cost and environmental impact would be minimised more than in cases with new construction. However, it is difficult to operate at high-travel speeds higher than a newly constructed road because of difficulty to meet road geometric design standards due to topographical constraints. As mentioned above, the Middle Ring Road is expected to function for traffic distribution connecting the existing Trunk Road at 80 km/h. Thus, new construction for the Middle Ring Road is recommended as of the Master Plan stage so that it can play a role as a high-standard road.

Road alignment study was roughly conducted as summarized in Table 10.2.7. Particularly, Figure 10.2.25 describes the existing situation around connecting point at the Morogoro Road. Considering the control points especially on scale of land acquisition, environment impact and construction cost, alternative-2 would be recommended.

Definition of evaluation for each item is as follows;

- Very Good: Most preferred (less impact, less cost etc.) of all alternatives
- Good: 2nd preferred
- Fai : 3rd preferred

Criteria of evaluation for each item are as follows;

- Impact on resettlement: Number of the affected buildings (less amount is preferable)
- Construction cost: Number of the affected buildings and road length (less amount is preferable)
- Environmental impact: Area of specific-used area (military base)
- Mobility: Road length (less amount is preferable)
- Accessibility: Connectivity with BRT station (Crossing point closer to the BRT station is preferable)

Safety: Passing area of road (Density built-up is not preferable)

On the other hand, there is a case that utilising the existing roads would be preferable. So, it is required to do feasibility study in order to decide on the better alignment from the side of consensus

formation with residents, related organisation or environmental impact. At the Master Plan stage, suggested road alignment of alternative-2 is not a definitive one.

To utilize the existing roads will be recommended at the next stage such as a feasibility study from the side of consensus formation with residents, related organisation or environmental impact. Therefore, suggested road alignment of alternative-2 is not a definitive one. As a basic policy, Middle Ring Road should connect Tegeta – Mbezi – Pugu – Airport Access.

Since the Middle Ring Road will pass through densely built-up area, delay of road improvement increasingly leads to utilizing of the existing road by widening.

Table 10.2.7 Alignment Comparison

Item	Alt−1 (L=29km)		Alt-2 (L=25km)		Alt-3 (L=23km)	
	Sec.1	Sec.2	Sec.1	Sec.2	Sec.1	Sec.2
Impact on resettlement	Fair	Fair	Very Good	Good	Fair	Fair
Construction cost	Fair	Fair	Very Good	Good	Very Good	Very Good
Environmental impact	Good	Good	Very Good	Good	Good	Good
Mobility	Good	Good	Good	Good	Very Good	Very Good
Accessibility	Very Good	Very Good	Good	Good	Very Good	Very Good
Safety	Good	Good	Very Good	Very Good	Good	Good
Recommended	Fair		Very Good		Good	

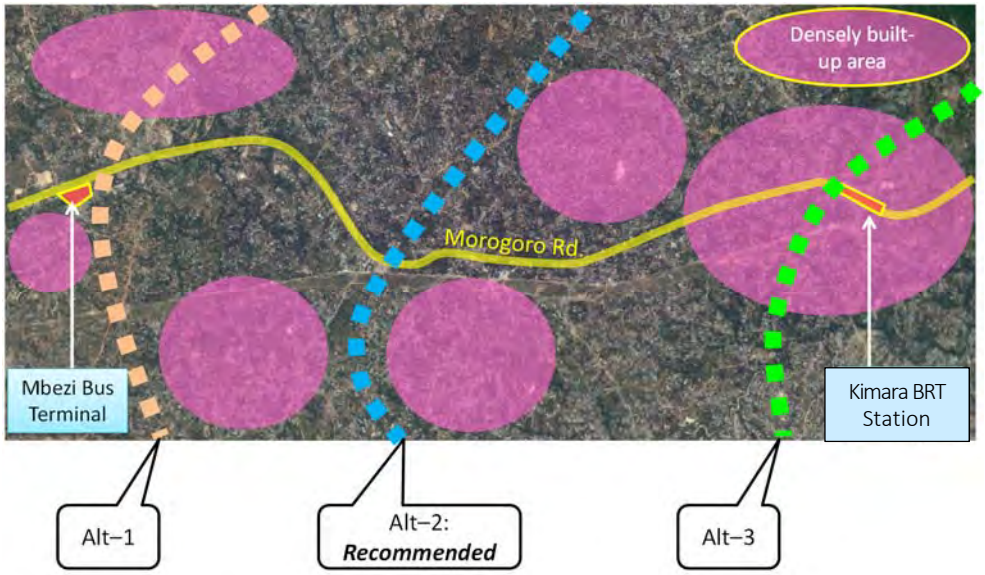


Figure 10.2.25 Existing Situation around Connecting Point at the Morogoro Road

d) ITS Technology to be Introduced

ITS Technology to be introduced is described in Figure 10.2.26.

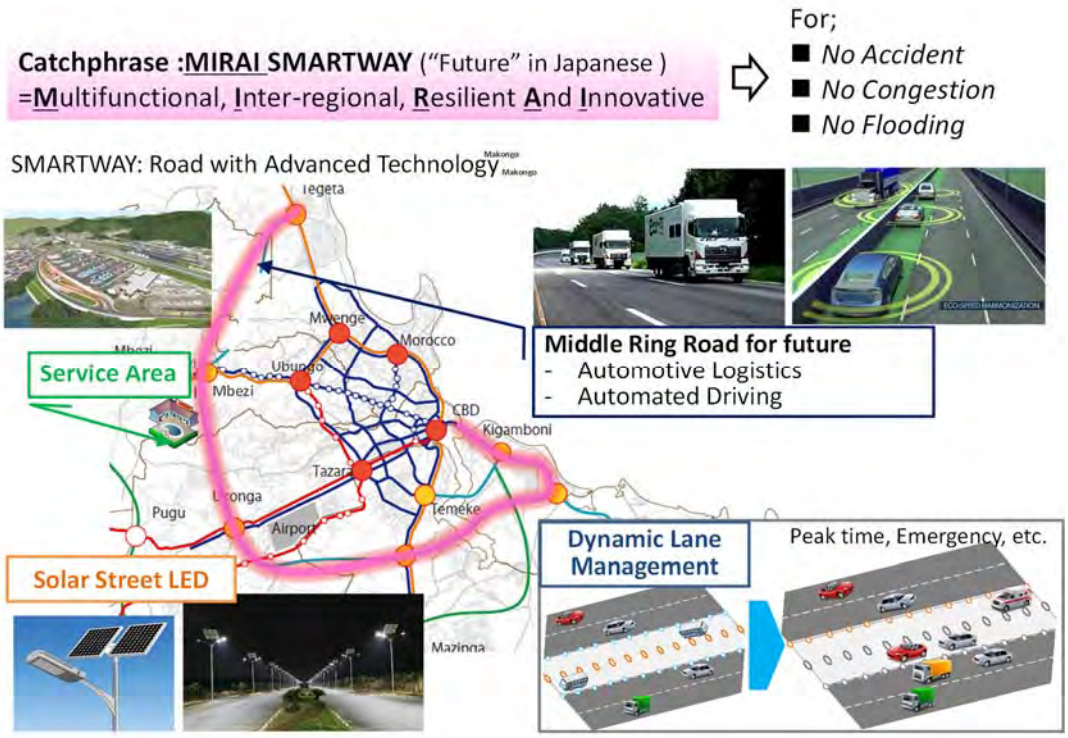


Figure 10.2.26 ITS to be Introduced

e) Flexible Traffic Operation

The multi-purpose lane can be flexibly used as explained in Figure 10.2.27 depending on the traffic situation.

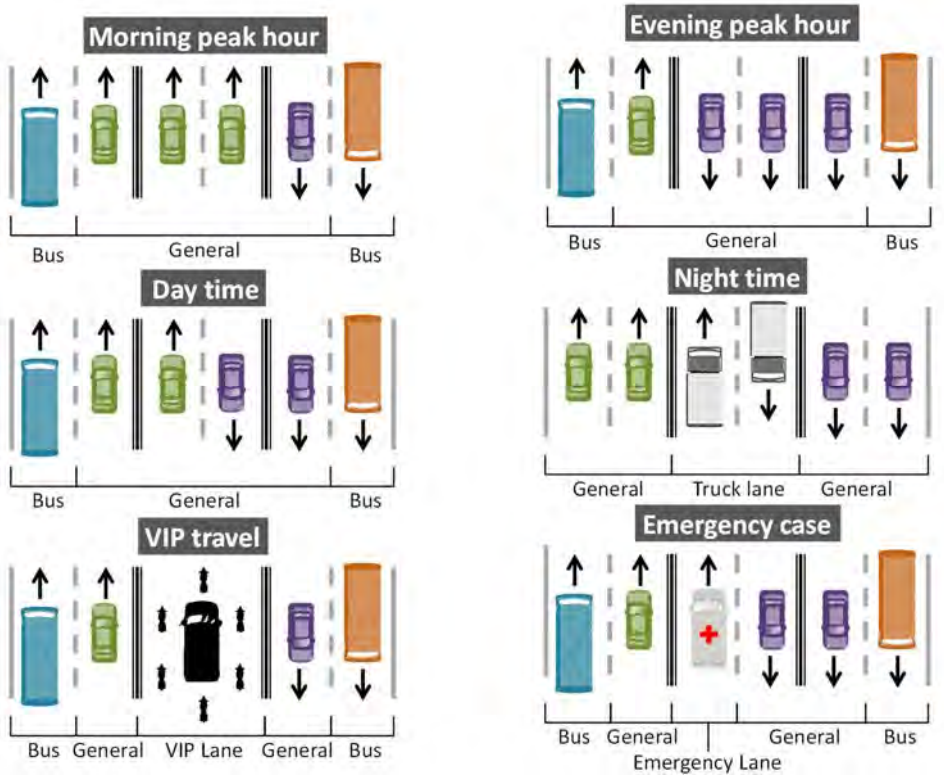


Figure 10.2.27 Flexible Traffic Operation

Table 10.2.8 explains that traffic volume in the morning peak accounts for one–third of traffic volume in the peak hours in a day. It means that flexible traffic operation of traffic lane as mentioned above would be reasonable in order to control traffic demand depending on time. In the future, this will be one of the effective ways for traffic control.

Table 10.2.8 Summary of D Value

D value
0.75<D
0.65<D<0.75
D<0.65

D value on Radial Roads

Morning Peak

Location	Traffic Volume(pcu/h)			D value	Peak Hour
	inbound	outbound	total		
CL-1	183.5	278.5	462.0	0.60	9:00-10:00
CL-2	257.5	635.5	893.0	0.71	6:00-7:00
CL-3	52.0	157.0	209.0	0.75	7:00-8:00
CL-4	283.8	417.8	701.5	0.60	7:00-8:00
CL-5	534.3	195.8	730.0	0.73	6:00-7:00
SL1-1	2,096.5	373.3	2,469.8	0.85	7:00-8:00
SL1-2	2,574.5	1,135.8	3,710.3	0.69	6:00-7:00
SL1-3	2,503.0	960.0	3,463.0	0.72	7:00-8:00
SL1-4	2,373.5	993.8	3,367.3	0.70	6:00-7:00
SL1-5	2,569.3	1,187.8	3,757.0	0.68	7:00-8:00
SL2-6	2,416.8	1,178.0	3,594.8	0.67	6:00-7:00
SL2-7	1,552.3	513.0	2,065.3	0.75	6:00-7:00
SL3-11	1,677.3	1,207.8	2,885.0	0.58	6:00-7:00
TVC-1	2,214.0	899.3	3,113.3	0.71	6:00-7:00
TVC-2	2,350.3	1,076.0	3,426.3	0.69	6:00-7:00
TVC-7	1,501.5	778.8	2,280.3	0.66	6:00-7:00
TVC-11	1,430.3	766.8	2,197.0	0.65	6:00-7:00
TVC-12	1,339.5	888.8	2,228.3	0.60	8:00-9:00
TVC-13	1,368.5	629.3	1,997.8	0.69	7:00-8:00
TVC-14	2,521.5	354.3	2,875.8	0.88	7:00-8:00

Evening Peak

Location	Traffic Volume(pcu/h)			D value	Peak Hour
	inbound	outbound	total		
CL-1	461.5	267.3	728.8	0.63	19:00-20:00
CL-2	875.0	511.3	1,386.3	0.63	14:00-15:00
CL-3	129.0	71.3	200.3	0.64	15:00-16:00
CL-4	295.0	426.3	721.3	0.59	14:00-15:00
CL-5	429.0	587.8	1,016.8	0.58	18:00-19:00
SL1-1	602.8	1,441.0	2,043.8	0.71	17:00-18:00
SL1-2	959.8	2,198.8	3,158.5	0.70	19:00-20:00
SL1-3	1,111.3	1,824.3	2,935.5	0.62	16:00-17:00
SL1-4	1,812.5	1,305.0	3,117.5	0.58	12:00-13:00
SL1-5	1,149.5	2,272.8	3,422.3	0.66	19:00-20:00
SL2-6	1,295.5	2,870.8	4,166.3	0.69	17:00-18:00
SL2-7	774.3	1,520.0	2,294.3	0.66	18:00-19:00
SL3-11	436.0	775.0	1,211.0	0.64	21:00-22:00
TVC-1	2,066.3	1,165.8	3,232.0	0.64	14:00-15:00
TVC-2	1,085.0	2,592.5	3,677.5	0.70	18:00-19:00
TVC-7	1,159.5	1,903.3	3,062.8	0.62	19:00-20:00
TVC-11	1,014.8	1,600.3	2,615.0	0.61	19:00-20:00
TVC-12	1,723.3	1,271.8	2,995.0	0.58	19:00-20:00
TVC-13	966.0	1,588.8	2,554.8	0.62	17:00-18:00
TVC-14	776.0	2,489.8	3,265.8	0.76	17:00-18:00

D Value on Ring Roads

Morning Peak

Location	Traffic Volume(pcu/h)			D value	Peak Hour
	inbound	outbound	total		
SL2-8	1,910.0	1,251.0	3,161.0	0.60	9:00-10:00
SL2-9	1,424.0	1,086.3	2,510.3	0.57	6:00-7:00
SL3-10	1,033.3	685.0	1,718.3	0.60	6:00-7:00
SL3-12	1,931.5	596.5	2,528.0	0.76	7:00-8:00
SL-16	844.0	289.0	1,133.0	0.74	7:00-8:00
TVC-3	1,636.3	1,118.5	2,754.8	0.59	11:00-12:00
TVC-4	1,480.8	801.5	2,282.3	0.65	7:00-8:00
TVC-5	1,146.8	831.5	1,978.3	0.58	6:00-7:00
TVC-6	1,827.5	190.8	2,018.3	0.91	7:00-8:00
TVC-8	1,468.3	2,700.8	4,169.0	0.65	8:00-9:00
TVC-9	752.8	407.3	1,160.0	0.65	6:00-7:00
TVC-10	612.3	446.3	1,058.5	0.58	9:00-10:00

Evening Peak

Location	Traffic Volume(pcu/h)			D value	Peak Hour
	inbound	outbound	total		
SL2-8	2,511.5	1,652.3	4,163.8	0.60	16:00-17:00
SL2-9	997.5	1,545.8	2,543.3	0.61	17:00-18:00
SL3-10	642.5	986.5	1,629.0	0.61	16:00-17:00
SL3-12	654.0	1,742.8	2,396.8	0.73	18:00-19:00
SL-16	222.5	445.3	667.8	0.67	19:00-20:00
TVC-3	1,522.0	1,036.3	2,558.3	0.59	18:00-19:00
TVC-4	714.0	498.8	1,212.8	0.59	19:00-20:00
TVC-5	857.3	1,154.5	2,011.8	0.57	19:00-20:00
TVC-6	382.8	1,467.8	1,850.5	0.79	18:00-19:00
TVC-8	2,173.0	1,170.5	3,343.5	0.65	14:00-15:00
TVC-9	553.5	986.8	1,540.3	0.64	17:00-18:00
TVC-10	532.8	971.3	1,504.0	0.65	16:00-17:00

f) Service Area

A service area, which is a public facility where drivers and passengers can rest, eat, or refuel without exiting onto secondary roads, is proposed on the Middle Ring Road. This not only includes toilets and restaurants, but also scenic spots, local specialities or charging stations for electric vehicles looking toward future use.

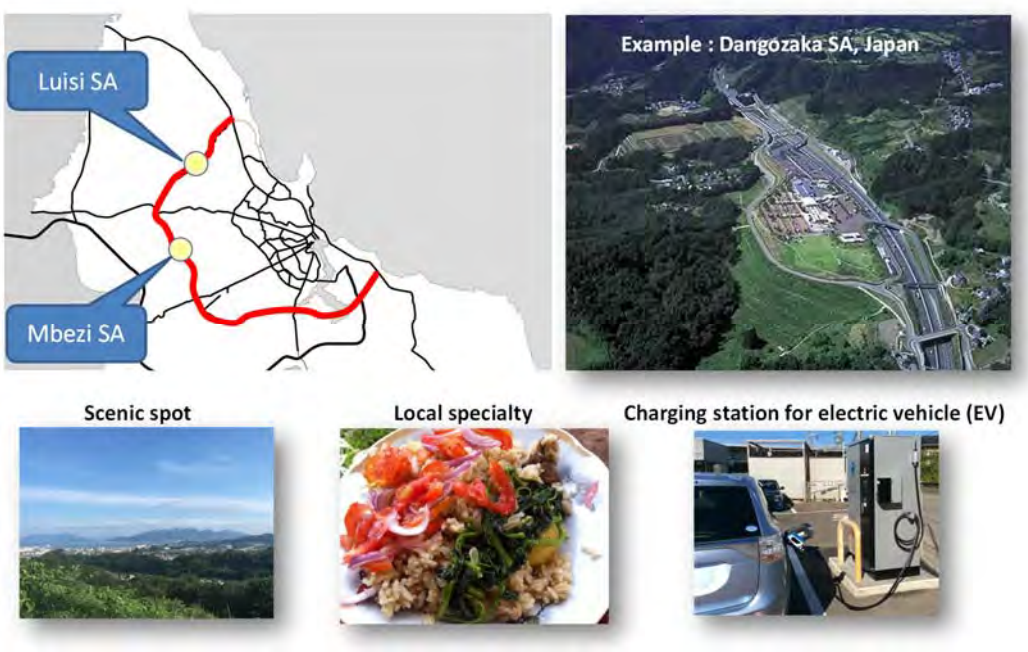


Figure 10.2.28 Proposed Service Area

(2) Connecting Structure on the Bay Link Road

a) Location

Bay Link Road is planned to connect the New Selander Bridge and Kigamboni area by the structure crossing over the bay at the point as indicated in Figure 10.2.29.

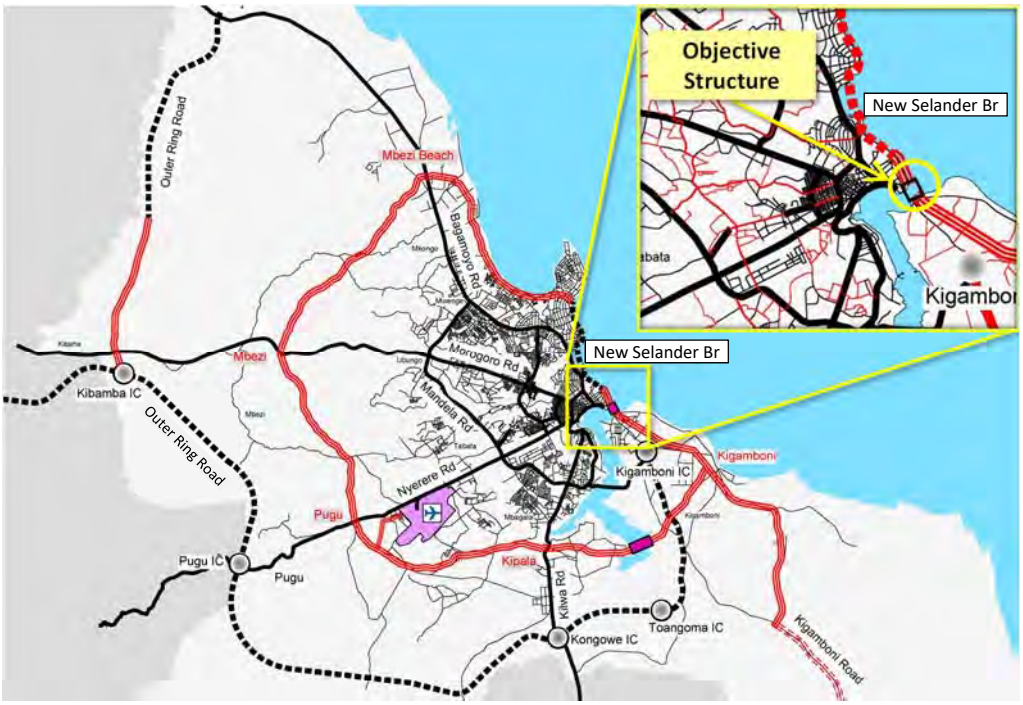


Figure 10.2.29 Location of Planned Structure

b) Existing Condition

Based on the existing conditions (Figure 10.2.30) provided by Tanzania Port Authority (TPA), structure location, plan and profile were roughly studied.

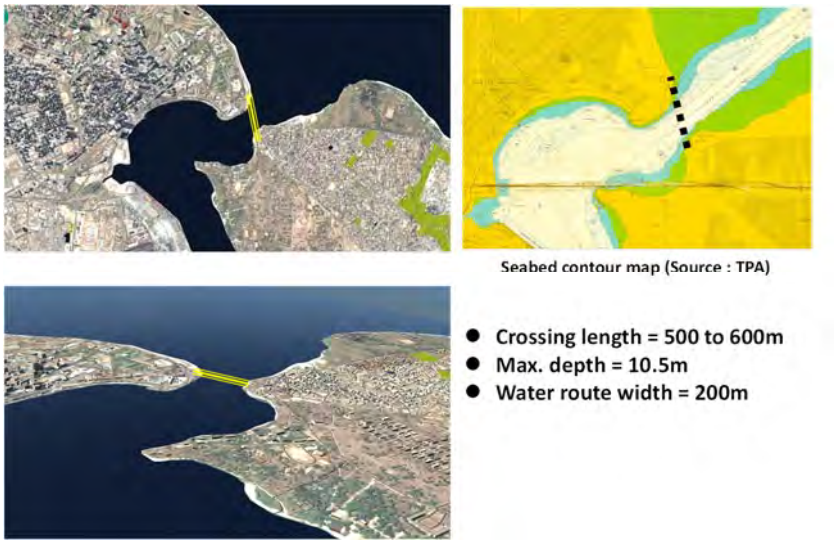
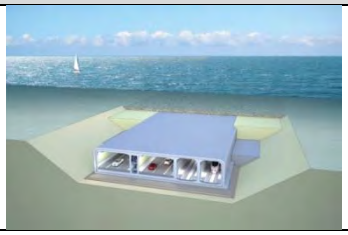
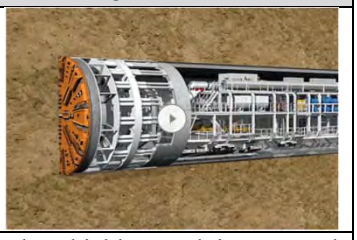


Figure 10.2.30 Existing Condition

c) Structure Comparison

TPA requests that 50m of vertical clearance from water level must be secured and it is not allowed to affect ships during construction. After considering the items in the comparison table, tunnel type (Alt-2 or Alt-3) is recommended as of the Master Plan stage. Detailed evaluation should be based on the feasibility study result, considering topographic/geological condition, impact for environment during construction and financial evaluation. For reference, in the Mombasa Port in Kenya, it is regulated as 69m vertical clearance and 15m depth for shipping route.

Table 10.2.9 Structure Comparison

Alternative	Alt-1. Bridge	Alt.-2 Immersed Tunnel	Alt.-3 Shield Tunnel
Image			
Description	In road construction work, it is a general structural form, and it is a feature that it can be a road structure with excellent landscape.	The outer shell boxes are preliminarily divided and manufactured, and dredge the water bottom to install in a groove shape and make foundation. The shell boxes are submerged and connected underwater, and refill with earth and sand outside the tunnel to complete.	The shield tunnel is a tunnel excavated by the shield machine. Tunnel walls behind the facing are temporarily supported by a cylinder called a "shield" while excavating excavations, sequentially advancing the shield, and build a wall behind the shield.
Approach Road	**[Longer]** It is necessary to secure a head clearance for vessel passing. Therefore, longer approach roads in both sides than the other alternatives are required.	**[Shorter]** In the immersed tunnel, the earth covering is generally about 1.5m to 2.0m. The approach distance is shorter than the bridge since required bottom clearance is less than head clearance. Therefore, total length of the structure can be shortened and the required construction area can be reduced.	**[Fair]** Profile is slightly deeper than an immersed tunnel. Therefore, the approach distance is longer than the one of an immersed tunnel.

Alternative	Alt-1. Bridge	Alt.-2 Immersed Tunnel	Alt.-3 Shield Tunnel
Impact during Construction	**[Bigger]** Impact during construction is significant since there is a need to temporarily shut off navigation of vessels. To adopt a bulk erection method by using a large hoist vessel is one of the effective methods.	**[Bigger]** Impact during construction is significant since there is a need to temporarily shut off navigation of vessels. To adopt a bulk erection method by using a large hoist vessel is one of the effective methods.	**[Smaller]** There is no impact for vessel passing.
Operation and Maintenance (O&M) Cost	**[Fair]** With the bridge monitoring system, below maintenance is made. ● To detect abnormality ● To inspect deterioration ● To do labor-saving maintenance for cost reduction O&M cost would be lowest of the three alternatives.	**[Higher]** Operation facilities necessary for the tunnel are lights, ventilation, fire-proofing, emergency exit, sidewalk for inspection and maintenance, and temporary generator system. More advanced tools or machines than bridge maintenance are required. Therefore, O&M cost would higher than the one of bridge.	**[Higher]** Operation facilities necessary for the tunnel are lights, ventilation, fire-proofing, emergency exit, sidewalk for inspection and maintenance, and temporary generator system. More advanced tools or machines than bridge maintenance are required. Therefore, O&M cost would higher than the one of bridge.
Applicability for BRT Operation	**[Fair]** It is inaccessible to the station due to long approach road	**[Very Good]** Approach road is shorter than the one of bridge.	**[Very Good]** Approach road is shorter than the one of bridge.
Construction Cost	Example (Tokyo Gate bridge 2.6km, 1,141 million USD)	Example (Tokyo Rinkai tunnel 5.7km, 1,100 million USD)	Example (Tokyo Ring Expressway Shinagawa 9.4km 3,729 million USD)
Recommended	**Fair**	**Good**	**Good**

(3) Grade-separation of Major Intersection

a) General

The ability to accommodate high traffic volumes efficiently through intersections depends on the arrangements of intersecting traffic. The greatest efficiency, safety, and capacity are attained when the intersecting travelled ways are grade separated (refer to following Photo). Objective intersections are shown in Table 10.2.10 and Figure 10.2.31.

Underpass

Flyover (Tazara Intersection)

Photo - Example of Grade-separation

Table 10.2.10 Objective Intersection List

ID	Name	Crossing Roads				Railway	Remarks
		Road Name	BRT	Road Name	BRT		
1	Ali Hassan Mwinyi / Kinondoni	Ali Hassan Mwinyi Rd	Phase-4	Kinondoni Road	No plan	No	Including improvement of existing Selander Bridge
2	Ali Hassan Mwinyi / United Nations	Ali Hassan Mwinyi Rd	Phase-4	United Nations Rd	No plan	No	
3	Chang'ombe	Nyerere Rd	Phase-3	Rashid Kawawa Rd	Existing	No	
4	Fire Station	Morogoro Rd	Existing	Msimbazi Street	Existing	No	
5	Magomeni	Morogoro Rd	Existing	Rashid Kawawa Rd	Existing	No	
6	Mandela / Uhuru	Nelson Mandela Rd	Phase-5	Uhuru Street	Phase-3	No	
7	Morocco	Bagamoyo Rd	Phase-4	Rashid Kawawa Rd	Phase-4	No	
8	Mwenge	Bagamoyo Rd	Phase-4	Sam Nujoma Rd	Phase-4	No	
9	United Nations	Morogoro Rd	Existing	United Nations Rd	No plan	No	
10	Tabata	Nelson Mandela Rd	Phase-5	-	-	Crossing	
11	Buguruni	Nyerere Rd	Phase-3	-	-	Crossing	

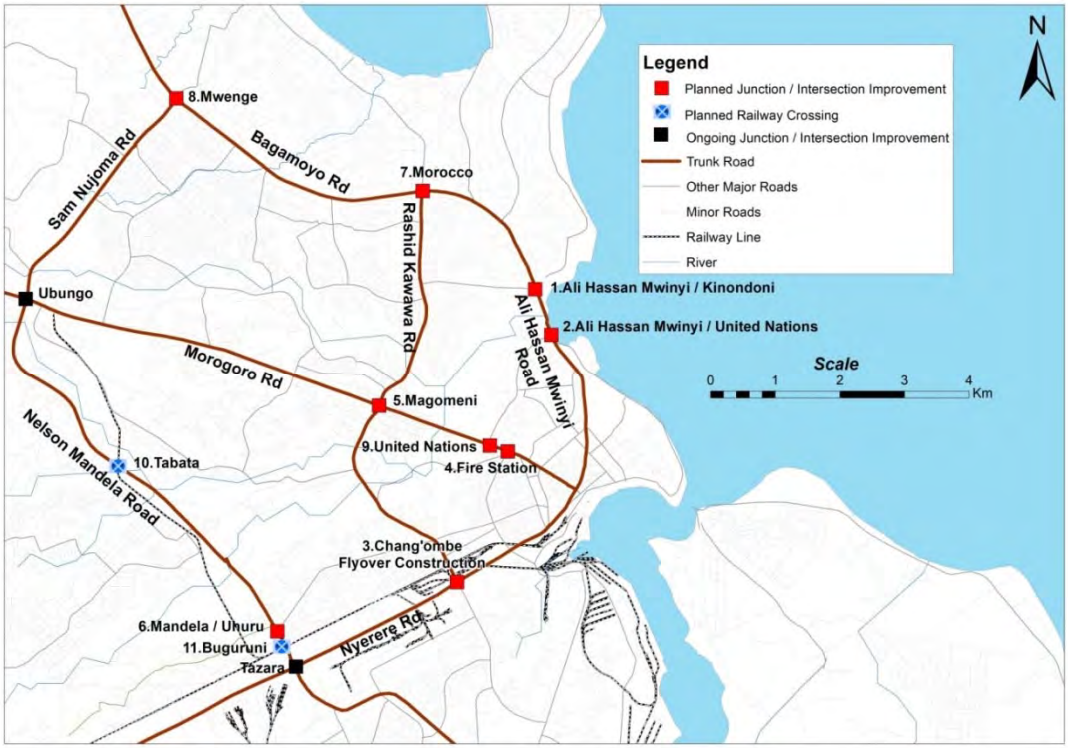


Figure 10.2.31 Objective Junctions Required to be Grade Separated

b) Priority Rank of Improvement

Priority rank is given for each intersection based on the evaluation result in Figure 10.2.32 and Table 10.2.11.

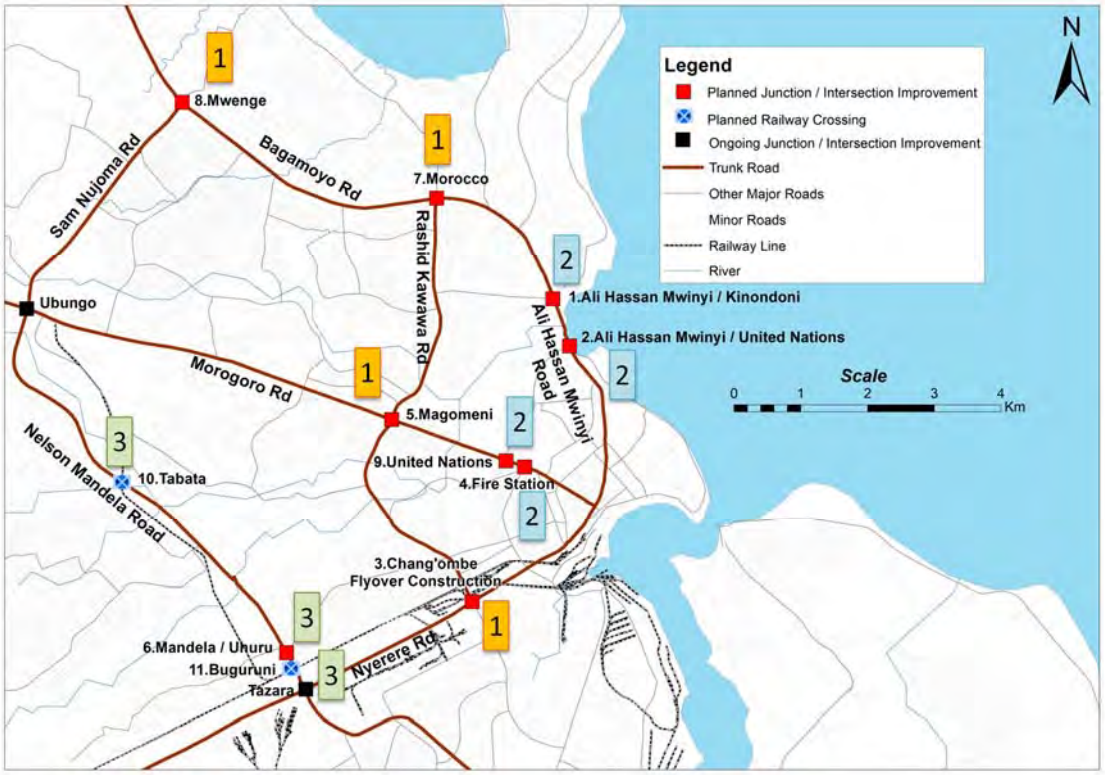


Figure 10.2.32 Improvement Priority Rank

Table 10.2.11 Improvement Priority Rank

No	Intersection Name	VCR			Flooding Risk	No. of Traffic Accident	Required time to pass through for the traffic as of 2030			Expected completion year of BRT and MRT connecting to intersections				Priority Rank	Expected Term
		2017	2030	2040			Without	With	Difference (Reduced time)	BRT	Year	MRT	Year		
1	Ali Hassan Mwinyi / Kinondoni	0.8	0.5	0.4	High	6	202	36	166 sec.	Phase-4	2022	Tegeta	2030	2*	Medium
2	Ali Hassan Mwinyi / United Nations	1.5	0.6	0.5	High	0	224	35	189 sec.	Phase-4	2022	Tegeta	2030	2*	Medium
3	Chang'ombe	1.2	1.6	1.3	Low	29	483	39	444 sec.	Phase-2	2020			1	Short
4	Fire Station	0.6	1.2	1.1	Low	1	140	45	95 sec.	Phase-1	Completed	-		2	Medium
5	Magomeni	1.1	1.6	1.4	Low	10	116	37	79 sec.	Phase-2	2020	-		1	Short
6	Mandela / Uhuru	0.9	1.6	1.5	Low	0	285	41	244 sec.	Pahse-5	2030			3	Long
7	Morocco	1.5	1.4	1.3	Moderate	17	142	37	105 sec.	Phase-4	2022	Tegeta	2030	1	Short
8	Mwenge	1.2	1.9	1.4	Moderate	9	353	45	308 sec.	Pahse-5	2030	Tegeta	2030	1	Short
9	United Nations	0.9	0.9	0.9	Low	0	81	42	39 sec.	Phase-1	Completed	-		2	Medium
10	Tabata**	0.4	1.4	1.2	Low	0	85	34	50 sec.	Pahse-5	2030	Loop	2030	3	Long
11	Buguruni**	0.4	1.6	1.5	Low	0	285	44	241 sec.	Pahse-5	2030	Loop	2030	3	Long

*In case that New Selander Bridge is not constructed until 2025, priority rank of these intersections would be raised to Rank 1 (sort term) including improvement of existing Selander Brdge. See following part about the details.

**Crossing structure of railway to the road might be an underpass depending on timing of commencement of construction.

c) Application of Continuous Grade Separation

In the section where intersections are located closely, multiple intersection improvements by applying continuous grade separated structure as shown in folwoing Photo would be occasionally much more effective than single improvement in terms of smooth traffic flow, although construction cost gets much higher.

For the sections highlighted by the red dotted line in Figure 10.2.33, continuous grade separation structure is proposed because it is more effective for not only neighbouring intersections but also for passing over Jangwani River where flooding often happens.

Photo - Example of Continuous Grade Separation

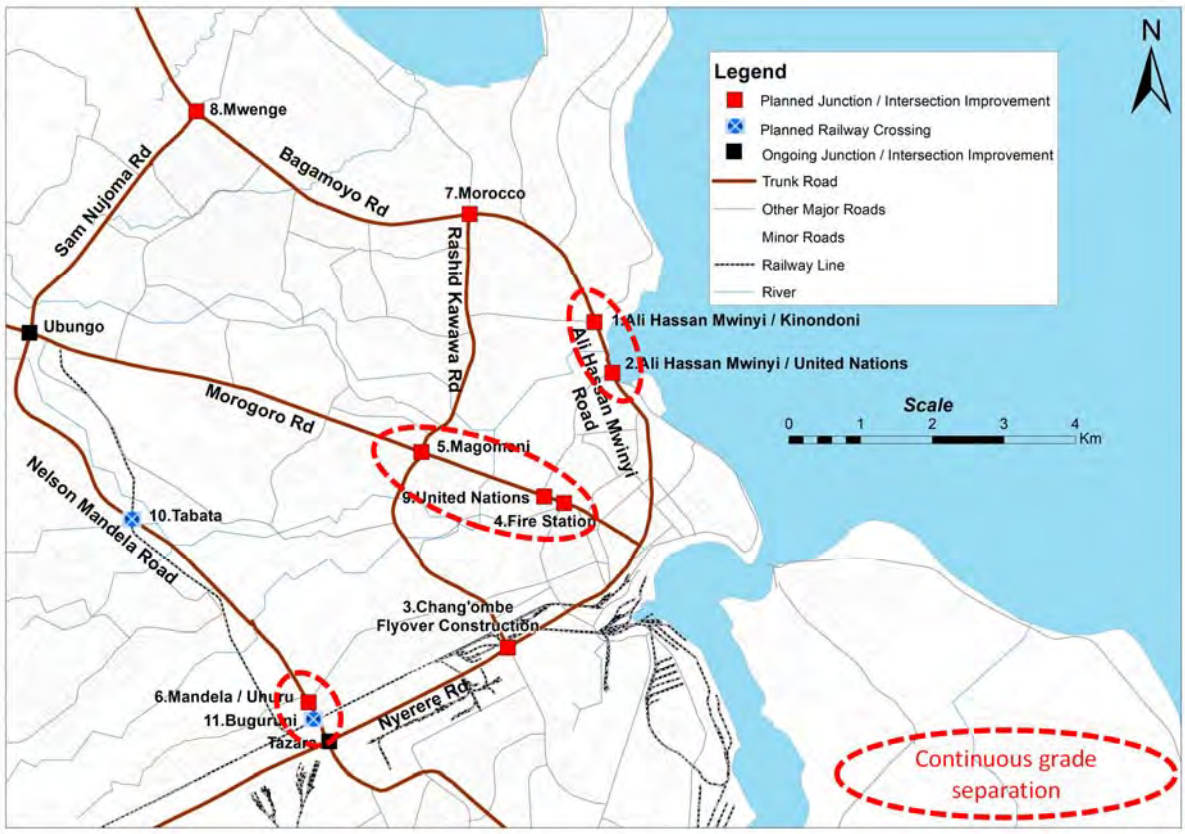


Figure 10.2.33 Location of Continuous Grade Separation

d) Improvement of Existing Selander Bridge

If in case the New Selander Bridge is not constructed until 2025, existing Selander Bridge should also be improved continuously along with Ali Hassan Mwinyi / Kinondoni and Ali Hassan Mwinyi /

United Nations as the countermeasure to increase traffic capacity on the Bagamoyo Road until 2025. This improvement scenario is shown in Table 10.2.12. Refer to Chapter 11 regarding the Implementation Plan by terms.

Table 10.2.12 Improvement Scenario of Existing Selander Bridge

Case	New Selander Bridge is constructed until 2025	No bridge is constructed until 2025
Structure	At-grade 6 lane	Two-layered carriageway
Typical Cross Section		  (Example in Fukuoka, JAPAN)
Description	4 lane carriageway + BRT lane	At-grade: 4 lane carriageway + BRT lane Second layer: 4 lane carriageway

e) Continuous Grade Separation on the Morogoro Road

For the smooth traffic operation for existing traffic flow with consideration for congestion expected to occur during construction, continuous grade separation on the Morogoro Road should be conducted divided into two phases by the proposed areas as shown in Figure 10.2.34.

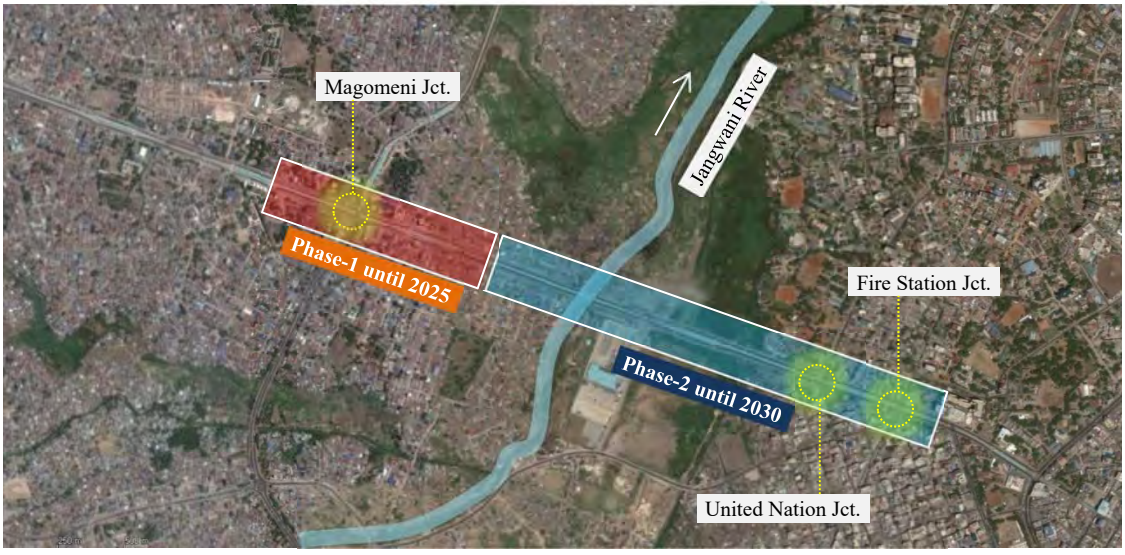


Figure 10.2.34 Phased Implementation of Continuous Grade Separation

(4) Flooding Prevention Measure

a) Inside of Nelson Mandela Road

It is difficult to install a new large-scale drainage facility inside Nelson Mandela Road since it is already fully urbanised.

Therefore, flood-prevention measures inside Nelson Mandela Road should be on the basis of the following points:

- Maintenance of existing drainage facility
- Timely information sharing by using ITS

b) Outside of Nelson Mandela Road

For the new roads, measures proposed in Figure 10.2.35 are recommended.

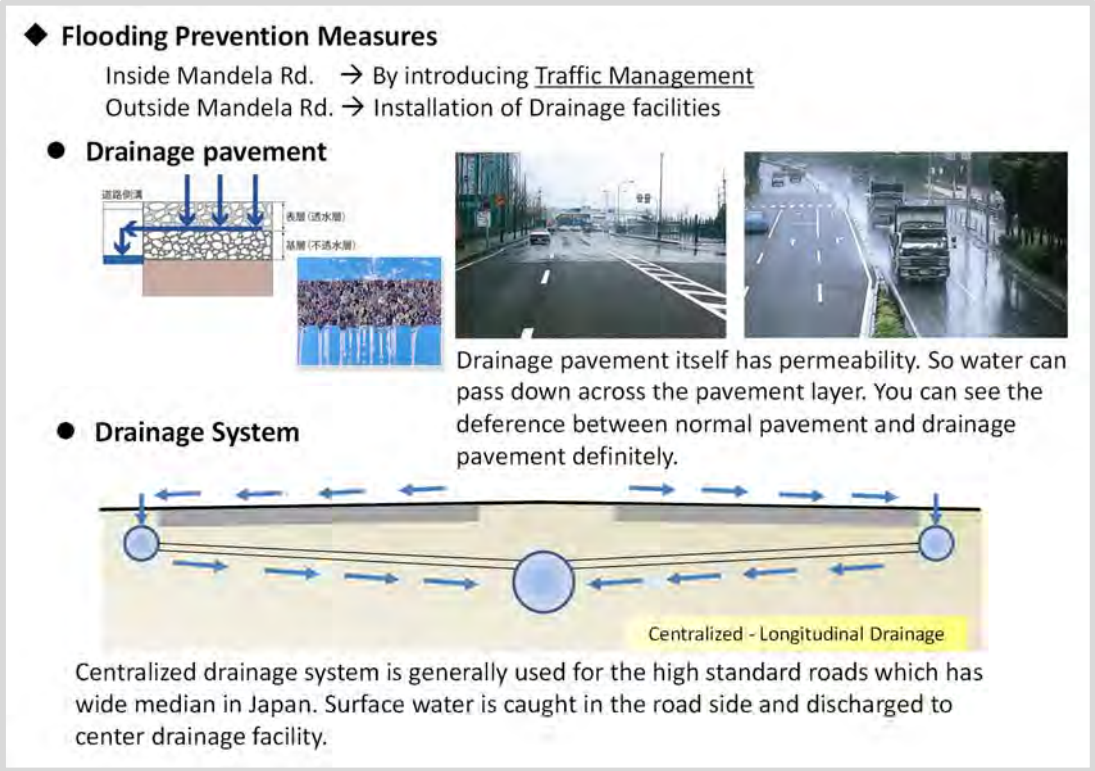


Figure 10.2.35 Proposed Flooding Prevention Measures

(5) Traffic Safety in Intersection

Outline of action plan for traffic safety in intersection is summarized in Figure 10.2.36.

Figure 10.2.36 Action Plan for Traffic Safety in Intersection

(6) Ensuring of Safety for Pedestrian

Outline of action plan for ensuring of safety for pedestrian is summarized in Figure 10.2.37.

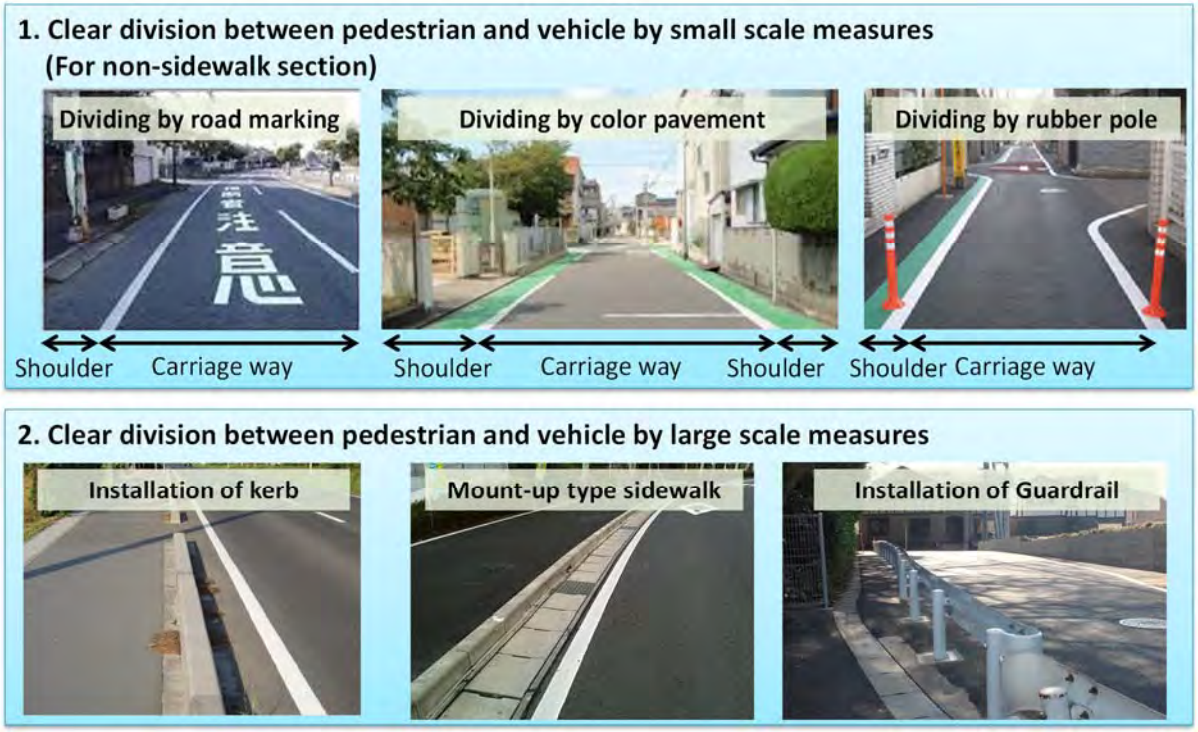


Figure 10.2.37 Action Plan for Ensuring of Safety for Pedestrian

10.2.6 Summary of Road Project

Proposed road projects are summarized in Table 10.2.13 and Figure 10.2.38. For the newly proposed road projects with the cost and executive agencies, see Chapter 11, section 11-4.

Table 10.2.13 Proposed Road Project List

S/N	Type	Project No.	Project Name	Location / Road Name	No. of carriageway lane	Work Type	Length (km)	Typical Cross Section ID
1	New Development	101	Dar Es Salaam - Chalinze Expressway	Chalinze – DSM	6	New	55.3	Type-A
2		102	New Selander Bridge	Ali Hassan Mwinyi Road	4	New	6.23	Type-B
3		103	Outer Ring Road	Bunju - Kibamba IC	4	New	22.2	Type-C
4		104	Middle Ring Road / New Kigamboni Bridge	Mbezi Beach - Mbezi - Pugu - Kipala – Kigamboni	4	New	48.3	Type-C
5		105	Airport Access Road	Middle Ring Road – JNIA	4	New	2.5	Type-C
6		106	Bay Link Road	New Selander Bridge - Kigamboni	4	New	1.7	Type-B
7		107	Kigamboni Road	Kigamboni	4	New	28.9	Type-BRT-4L
8	BRT	201	BRT Phase-1 Extension	Morogoro Road	4	Widening (2 lane to 6 lane)	6.5	Type-BRT-4L
9		202A	BRT Phase-2 Port section	Gerezani - Bandari	2	Widening (2 lane to 4 lane)	2.7	Type-BRT-2L
10		202B	BRT Phase-2 Kilwa direction	Bandari-Kilwa	4	Widening (4 lane to 6 lane)	11.1	Type-BRT-4L
11		202C	BRT Phase-2 Chang'ombe direction	Chang'ombe s-Kigogo-Mpiji street	4	Widening (4 lane to 6 lane)	6.3	Type-BRT-4L
12		203A	BRT Phase-3 Nyerere direction	Samora-Nyerere	4	Widening (4 lane to 6 lane)	15.7	Type-BRT-4L
13		203B	BRT Phase-3 CBD-Uhuru direction	CBD-Uhuru st	2	Widening (2 lane to 4 lane)	6.9	Type-BRT-2L
14		204A	BRT Phase-4 Bagamoyo direction	Ali hassan - Bagamoyo	4	Widening (4 lane to 6 lane)	16.9	Type-BRT-4L

S/N	Type	Project No.	Project Name	Location / Road Name	No. of carriageway lane	Work Type	Length (km)	Typical Cross Section ID
15		204B	BRT Phase-4 Mandela direction	Mwenge Jct - Sam Nujoma	4	Widening (4 lane to 6 lane)	3.9	Type-BRT-4L
16		205A	BRT Phase-5 United direction (New Construction including new bridge in DMDP)	UN - Kawawa - Sam Najona	2	New	1.4	Type-BRT-2L
17		205B	BRT Phase-5 United direction		2	Widening (2 lane to 4 lane)	8.2	Type-BRT-2L
18		205C	BRT Phase-5 Mandela direction	Ubungo Jct - Mandela	4	Widening (4 lane to 6 lane)	9.2	Type-BRT-4L
19		205D	BRT Phase-5 Feeder	Temeke - Mbagala	2	Widening (2 lane to 4 lane)	5.5	Type-BRT-2L
20		206A	BRT Phase-6 Fire - Mandela section (New Construction)	Fire Jct - Kigogo - Mandela	2	New	1.1	Type-BRT-2L
21		206B	BRT Phase-6 Fire - Mandela section		2	Widening (2 lane to 4 lane)	4.8	Type-BRT-2L
22		206C	BRT Phase-6 Kigogo - Old Bagamoyo section	Kigogo - Morogoro - Bagamoyo - Old Bagamoyo	2	Widening (2 lane to 4 lane)	12.1	Type-BRT-2L
23		206D	BRT Phase-6 Beach direction	Morocco Jct - Mwai kibaki - Old Bagamoyo	4	Widening (2 lane to 6 lane)	7.8	Type-BRT-4L
24		206E	BRT Phase-6 Mwalimu Nyrerere Bridge (Kigamboni Bridge)	Mwalimu Nyrerere Bridge (Kigamboni Bridge)	6	Use of existing road	0	-
25		206F	BRT Phase-6 After Mwalimu Nyrerere Bridge (Kigamboni Bridge) (median modification)	End of Mwalimu Nyrerere Bridge (Kigamboni Bridge) - Kigamboni	6	Modification of median to pavement for BRT lane	3.1	Type-BRT-4L
26		206G	BRT Phase-6 After Mwalimu Nyrerere Bridge (Kigamboni Bridge)	Kigamboni - Middle Ring Road	6	Widening (2 lane to 6 lane)	1.3	Type-BRT-4L
27		207	BRT Phase-7 Kigamboni Road (= No. 107)	Kigamboni	4	New	28.9	Type-BRT-4L
28	Improvement of existing arterial road	301A	Widening of Old Bagamoyo Road (North)	Mbezi Beach	4	Widening (2 lane to 4 lane)	6.5	Type-B

S/N	Type	Project No.	Project Name	Location / Road Name	No. of carriageway lane	Work Type	Length (km)	Typical Cross Section ID
29		301B	Widening of Old Bagamoyo Road (South)	Msasani Peninsula	4	Widening (2 lane to 4 lane)	3.4	Type-B
30		302	Widening of New Bagamoyo Road		4	Widening (2 lane to 4 lane)	13.7	Type-B
31		303	Widening of Morogoro Road	Kimara-Kibaha	4	Widening (2 lane to 4 lane)	11.9	Type-B
32		304	Widening of Nyerere Road	TAZARA - JNIA	4	Widening (2 lane to 4 lane)	7.0	Type-B
33		305	Widening of Kilwa Road	Mbagala – Kongowe	4	Widening (2 lane to 4 lane)	3.3	Type-B
34		306	Widening of Mandela Road	Dar Port – TAZARA	6	Widening (2 lane to 6 lane)	9.1	Type-D
35		307	Approach road to Mwalimu Nyrerere Bridge (Kigamboni Bridge)	-	4	New	3.1	Type-E
36	Improvement of existing collector road	401	Upgrading of Existing Road Inside Mandela Rd.	Inside Mandela Rd.	2	Upgrading (Paving)	73.8	Type-F
37		402	New Construction of Collector Road from Mandela Rd. to MRR	From Mandela Rd. to MRR	2	New	4.8	Type-G
38		403	Upgrading of Existing Road from Mandela Rd. to MRR	From Mandela Rd. to MRR	2	Upgrading (Paving)	172.2	Type-G
39		404	New Construction of Collector Road from MRR to OTR	From MRR to OTR	2	New	3.4	Type-G
40		405	Upgrading of Existing Road from MRR to OTR	From MRR to OTR	2	Upgrading (Paving)	372.4	Type-G
41	Intersection Improvement	501	Ali Hassan Mwinyi / Kinondoni	-	-	Improvement (Flyover)	-	-
42		502	Ali Hassan Mwinyi / United Nations	-	-	Improvement (Flyover)	-	-

S/N	Type	Project No.	Project Name	Location / Road Name	No. of carriageway lane	Work Type	Length (km)	Typical Cross Section ID
43		503	Chang'ombe Fly over Construction	-	-	Improvement (Flyover)	-	-
44		504	Fire Station	-	-	Improvement (Flyover)	-	-
45		505	Magomeni	-	-	Improvement (Flyover)	-	-
46		506	Mandela / Uhuru	-	-	Improvement (Flyover)	-	-
47		507	Morocco	-	-	Improvement (Flyover)	-	-
48		508	Mwenge	-	-	Improvement (Flyover)	-	-
49		509	United Nations	-	-	Improvement (Flyover)	-	-
50		510	Tabata	Railway (at grade) vs. Road (over)	-	Improvement (Flyover)	-	-
51		511	Buguruni	Railway (at grade) vs. Road (over)	-	Improvement (Flyover)	-	-
52	DMDP	601	DMDP-01 Temeke - Mbagala Road (3.5 km) - 4 lanes	This is included in 205C and 205D	4	Widening (2 lane to 4 lane)	3.5	-
53		602	DMDP-02 Chang'ombe Road (2.8 km) - 4 lanes	-	4	Widening (2 lane to 4 lane)	2.8	Type-B
54		603	DMDP-03 Shekilango Road (4km) - 4 lanes	-	4	Widening (2 lane to 4 lane)	4.0	Type-B
55		604	DMDP-04 2 lane - Paving	-	2	Upgrading (Paving)	37.7	Type-B

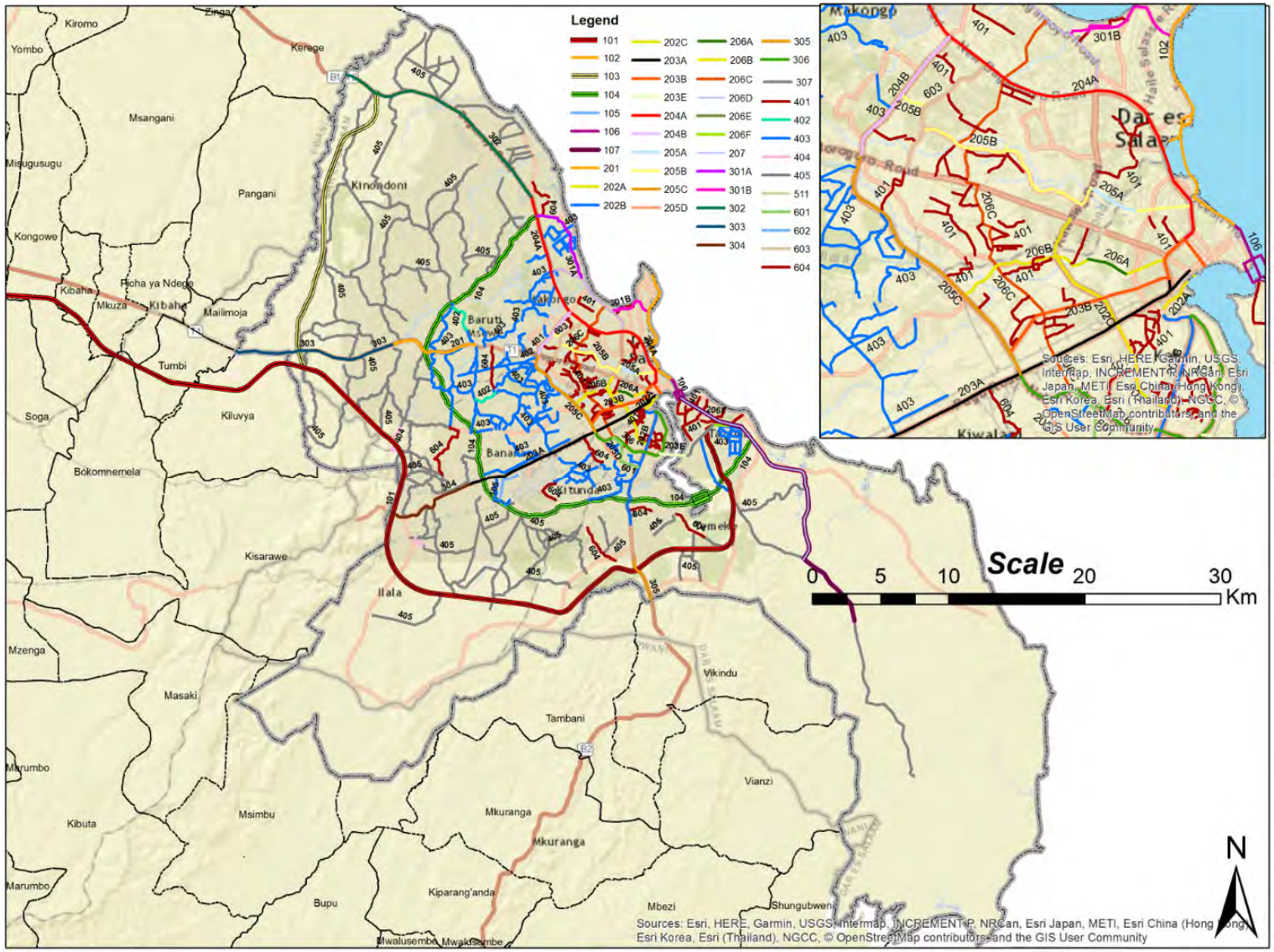


Figure 10.2.38 Proposed Typical Section by the Road Project

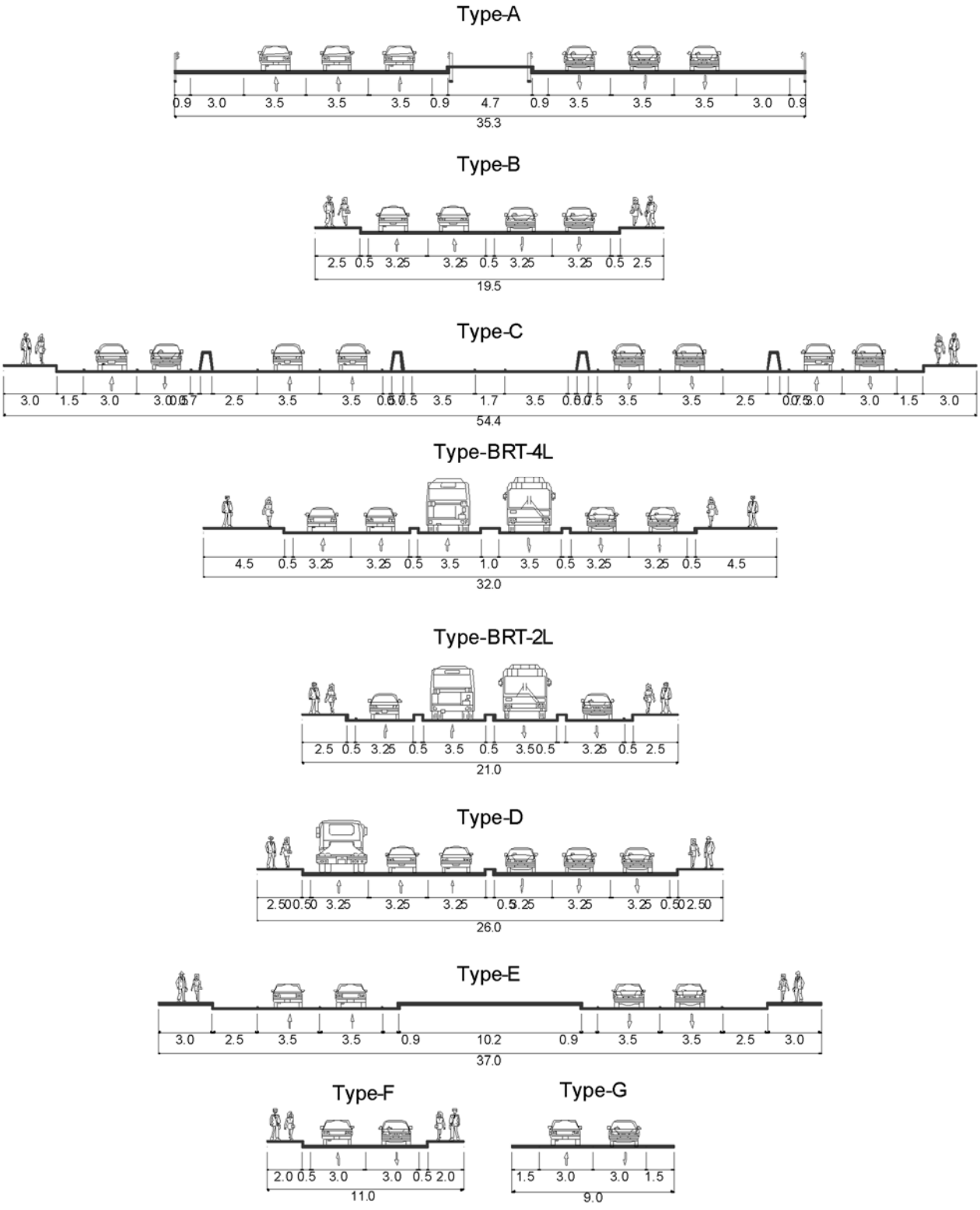


Figure 10.2.39 Proposed Typical Section by the Road Project

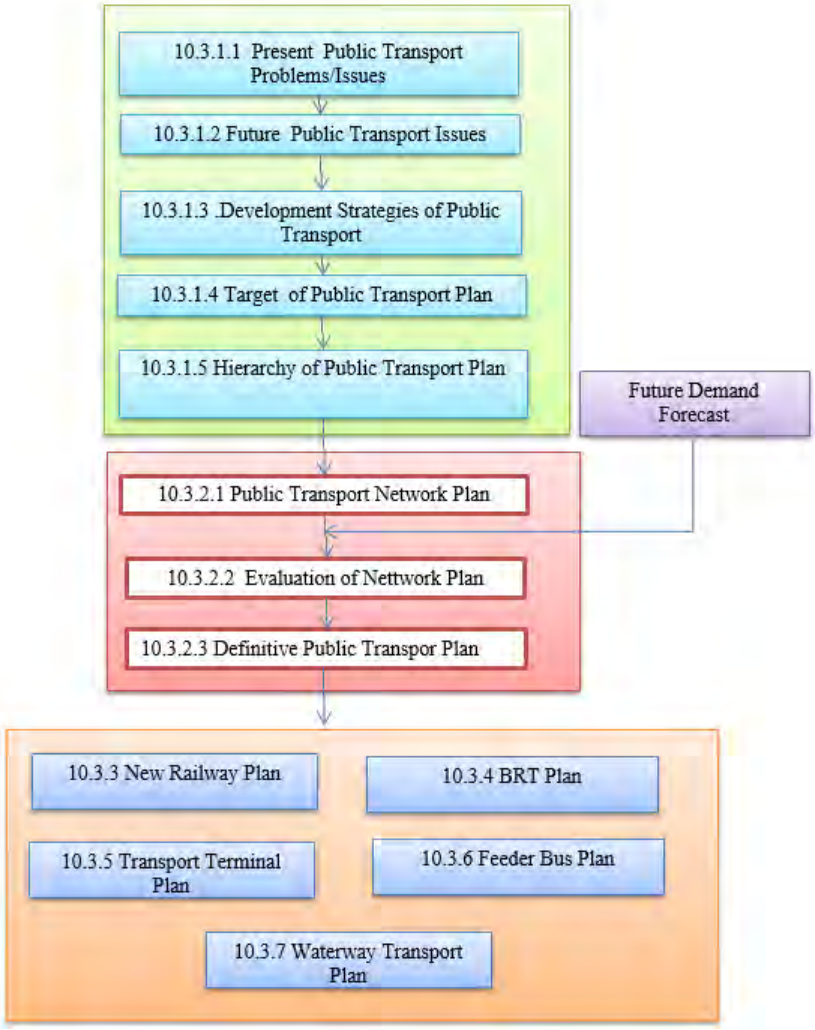
10.3 Public Transport Plan

Public Transport Plan is the key component in realising the desirable urban vision in DSM.

To accommodate the future demand and to realise proper urban expansion, the collaboration and integration of new railway and BRT system is proposed. To implement this public transport plan, the following target will be achieved: 1) most public transport users can reach the CBD within one hour, 2) in central area (within Nelson Mandela Road), everybody can move within 30 minutes by public transport and 3) modal shift from private vehicle use to public transport use will mitigate the road traffic congestion, 4) volume capacity ratio is less than 1.00 (it will be better than the present condition).

This section shows the analytical results of the study.

To formulate the public transport plan in 2040, the following procedures were undertaken (see in Figure 10.3.1). The proposed public transport network was evaluated based on the future traffic demand and identified the definitive plan in 2040. The future public transport system composed of railway (especially MRT), BRT, terminal, feeder bus system and waterway transport in Dar es Salaam.



Source: JST

Figure 10.3.1 Flowchart of Public Transport Plan

10.3.1 Public Transport Strategy

(1) Present Public Transport Problems/Issues

Based on section 5.1.4 (6) "Summary of Present Public Transport Service", the present public transport problems and issues are summarized in Table 10.3.1.

Table 10.3.1 Summary of Present Public Transport Problems/Issues

Items	Present Problems/Issues
1) Mobility	Average travel speed of railway and BRT is not so bad more than 20km/h. However, the speed of Daladala depends on the road traffic congestion (10-18km/h).
2) Accessibility (Service Area)	Currently public transport service is not fully covered in the suburban area, thus, is inaccessible for the users.
3) Punctually/ Convenience	(Operation hours) about 5A.M. to 11P.M. (Railway operation is only three times a day, during morning and evening peak hours) BRT operation is of high frequency. Daladala drivers wait for passengers to become full. No definite time table for Daladala users.
4) Affordability	Public Transport Fare (Rail, BRT and Daladala) in Dar es Salaam is 400 - 800 TZS, which is more affordable than private car's transport cost [4,250 TZS]. *See section5.1.4 (6)*
5) Comfortability	BRT buses and Daladala are very crowded; many passengers do not feel comfortable. Some existing Daladala terminals are not in good condition (unpaved, crowded, many standing passengers, etc.)
6) Safety	Daladala has many traffic accidents according to DART due to ill driving manners of drivers. Traffic accidents occur at BRT mix lane with motorcycle and pedestrian crossing. Flood disturbance during heavy rain is not only for road traffic, but also for public transport. BRT route passes through a lowland area at Jangwani, which closes during heavy rainfall. Public Transport System should be considered were strong transport system.

Source: JST

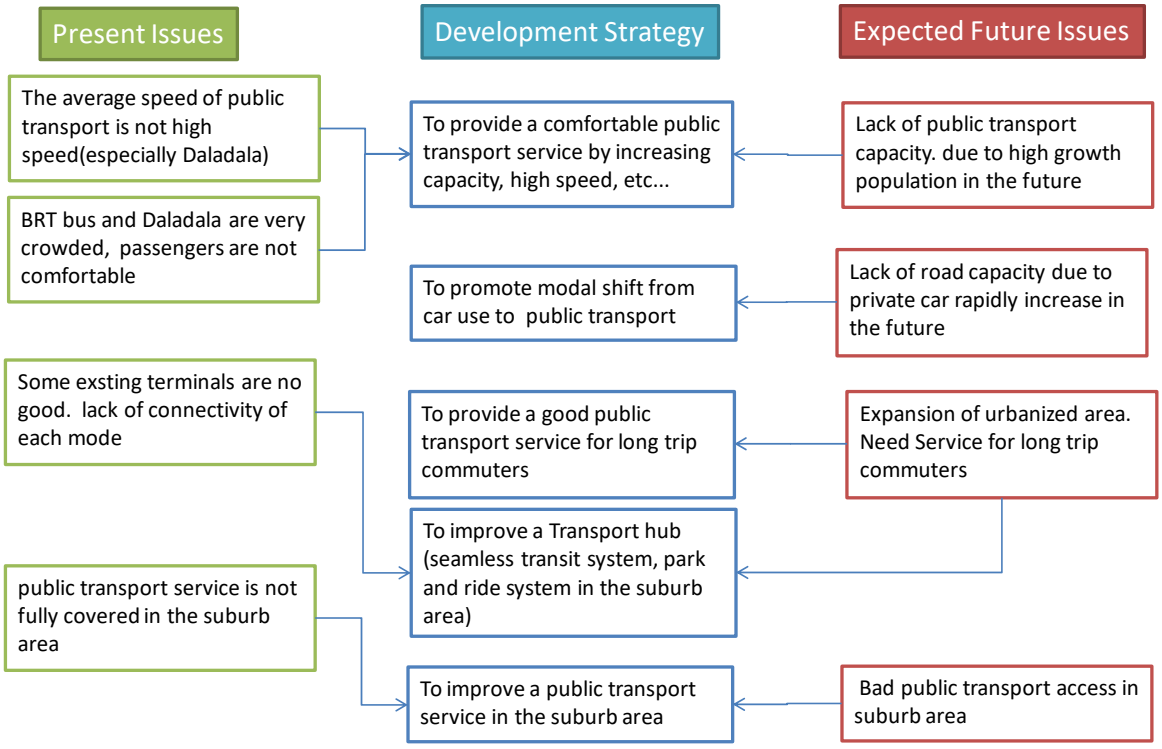
(2) Expected Future Public Transport Problems/Issues

The following public transport problems/issues will be expected if there were no development of public transport system:

- Lack of public transport capacity in the future due to high population growth in Dar es Salaam.
- No consideration of public transport system due to rapid urban development expansion (long trip commuters) in Dar es Salaam.
- Lack of road capacity in the future due to high demand for private vehicles; annual vehicle registration growth is currently 14% (the modal shift from private vehicle use to public transport use should be highly encouraged and considered.)
- Lack of consideration with the public transport access in suburban areas and terminal facilities.

(3) Development Strategies of Public Transport Plan

From present issues and expected future problems and issues, the development strategies of the public transport plan were identified in Figure 10.3.2 and Table 10.3.2.



Source: JST

Figure 10.3.2 Development Strategies of Public Transport Plan

Table 10.3.2 Development Strategies of Public Transport Plan

- To provide a comfortable public transport service by increasing public transport capacity (high mobility, accessibility, convenience, affordability, comfortability and safety).
- To promote modal shift from private vehicle use to public transport use.
- To provide good public transport service for long trip commuters according to future suburb development; high speed and punctual public transport mode.
- To improve a transport hub (seamless public transport system, park and ride system in the suburban area).
- To improve public transport service in the suburban areas, especially strength of feeder bus network.

Source: JST

(4) Target of Public Transport Plan

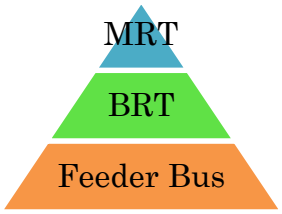
For the development strategies, it is important to set a quantitative target to easily understand the future public transport plan.

- Most public transport users in Dar es Salaam can reach the CBD within one (1) hour (average speed of public transport is 20-30 km/h).
- In the Central Area (within Nelson Mandela Road), everybody can move within thirty (30) minutes by public transport.

- Public transport development will contribute to the mitigation of the road traffic congestion by modal shift from private vehicle use to public transport use. With road development, the volume-capacity ratio along trunk roads is less than 1.00 (it will be better than the present condition).

(5) Hierarchy of Public Transport Plan

To formulate a public transport development plan, it is important to define the hierarchy of future public transport system. Even though the BRT and the Daladala were currently considered as the major public transport system in Dar es Salaam, the Mass Rail Transit (MRT), BRT and feeder Bus will be considered as part of the public transport system in the future as shown in Figure 10.3.3.



Mode	**CAPACITY** (PHPDT*)	**SPEED (km/h)**	**TRIP LENGTH**	**ACCESSIBILITY (Station interval)**	**CONGESTION RATES during peak hour** (see Table 10.3.3)
MRT	20,000～60,000 *Capacity depends the number of coach (4-10coach) and operation frequency (3-10min. interval)*	Max. 110km/h Ave. 35-45km/h	Medium-Long *(for long trip commuter)*	2-3km interval	Less than 150%
BRT	5,000～20,000	Max. 60km/h Ave. 20km/h	Short-Medium	500m interval	Less than 150%
Feeder Bus	～ 2,000* *=30pax*60bus/hour*	Max. 60km/h Ave. 10-15km/h* It depends on road condition.	Short	300-400m interval	-

*PHPDT: Peak Hour Peak Direction Traffic (transportation)

Source: JST

Figure 10.3.3 Proposed Hierarchy of Public Transport Plan

Table 10.3.3 Definition of Congestion Rate

100%	150%	180%	200%	250%
				
All passenger can seat, grasp strap or handrail.	Passenger's shoulder only touches each other.	Passenger's body touches each other, but it is possible to read newspaper.	Passengers are crowded each other, but it is possible to read magazine.	Passengers are stuffed, and can not move their hands.

Source: The Association of Japanese Private Railways

In Japan, the target congestion rate is a maximum of 150%.
The strategic targets of the future public transport system are set up as shown in Table 10.3.4. The targets are divided into five items.

Table 10.3.4 Strategic Target of Future Public Transport System

Keyword	Indicator	Strategic Target (Current Situation)
1. Mobility	MRT, BRT Operation Speed	Desirable Speed 35km/h in peak hour, at least 20km/h (10-18km/h in peak hours)
	Feeder Bus Operation Speed	Speed 15km/h in peak hours (10-18 km/h in peak hour)
2. Accessibility	Distance to station and bus stop	Within 500m inside the Middle Ring Road
3. Punctuality	Delay Time	Within 15 minutes of delay time a primary route for 5km movement. (if speed of bus is 30km/h, it takes 10 minutes for bus, although it takes 30 minutes for 5km at the speed of 10km/h)
4. Affordability	Fare	Cheaper than the price by motorcycle for 5km. For example, if the motorcycle runs at the speed of 20km/h, it consumes 0.25l/5km; if the price of petrol is 2000 TZS, it cost 500 TZS for 5km run. (Daladala - 10km, 400 TZS)
5. Comfortability	Comfortable ride, Universal Design	Lower Floor Bus Vehicle, Slope Elevator installation for transport terminal such as Rail/BRT station and terminal (no elevated facility).
		Sufficient priority seats for the disabled, old, children and pregnant women. (several seats for BRT only)
6. Efficiency	Number of passenger per vehicle	Forty (40) passengers per vehicle equals approximately two times of the current (20 passengers per vehicle)

Source: JST

10.3.2 Public Transport Network Plan

(1) Principles of Public Transport Network Hierarchy

Public transport network should be recognised to a new hierarchy consisting three kinds of public transport routes.

- Primary Route
- Secondary Route

- Tertiary Route

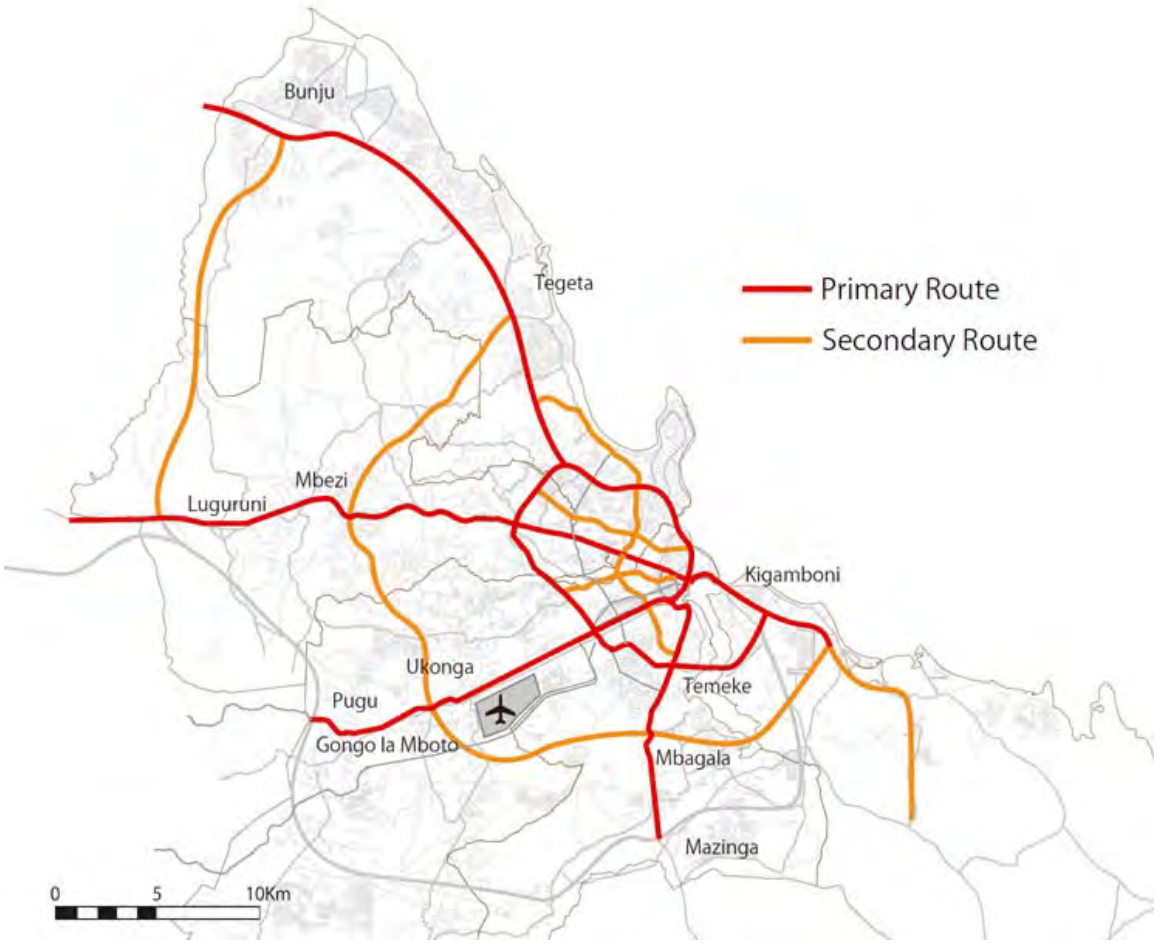
Table 10.3.5 shows the classification and the definition of public transport network.

Table 10.3.5 Classification and Definition of Public Transport Plot work

Classification and Definition	Demand in link	Vehicle	Speed*
Primary route is for ▪ High demand link on the axis of infrastructure ▪ Linkage to the CBD and sub-centre, Satellite City. ▪ Circulating in high density area (Central Area) ▪ Link with high speed, frequency and capacity ▪ Link with punctual operation with exclusive space	**(passengers/day)** ▪ More than 200,000 **(passenger/h/direction)** ▪ More than 10,000	▪ MRT ▪ BRT	More than 30km/h (BRT 20km/h)
Secondary route is for ▪ Medium demand link ▪ Next candidate route for the primary route ▪ Complemental route for primary route ▪ Convenient transfer route to primary route	**(passenger/day)** ▪ More than 50,000 and less than 200,000 **(passenger/h/direction)** ▪ More than 3,000 and less than 10,000	BRT Large Bus Medium Bus	More than 15km/h
Tertiary route is for ▪ Relatively low demand link ▪ Feeder access to bus stop ▪ Link to inconvenient areas	**(passengers/day)** ▪ Less than 50,000 **(passenger/h/direction)** ▪ Less than 2,000	Medium Bus Mini Bus	More than 15km/h

*Note: Speed is the travel rate on route including getting on and off time.
Source: JST

Figure 10.3.4 shows public transport network plan showing only primary route and secondary route. Tertiary route is the collector road shown as the grey line.



Source: JST

Figure 10.3.4 Public Transport Network Plan

(2) Evaluation of Public Transport Network

(1) Case Setting

To identify the future public transport network and public transport mode, the demand forecast of the following cases were conducted. Case-1 is set to verify whether BRT line is enough as the only future public transport network. Case-2 is set to verify whether there is enough demand to overlap with BRT and MRT. The only difference of Case-1 and Case-2 is whether to have MRT Projects or not.

Table 10.3.6 Traffic Demand Forecast

Case	Case Name	Road	BRT	Railway
Case-0	Do Nothing Case	Existing	Existing and Ongoing (Phase-1,2,3 and 4)	Existing
Case-1	BRT Only Case	All Road Projects	All BRT Projects - Phase-1-6 - Kigamboni line	Existing
Case-2	Master Plan Case			MRT - Loop line - Bagamoyo line - Morogoro line

Source: JST

(2) Transport Demand Analysis

Table 10.3.7 shows the result of future total trips in Dar es Salaam. Total trips in 2040 will increase by 1.9 million trips and is expected to be 2.19 times the total trips in 2017. In the case of do nothing (Case-0), car/ motor cycle trips (= private trips) will drastically increase by 3.17 times the trips in 2017. In case of master plan case (Case-2), private trips can be decreased to provide good public transport service.

Table 10.3.7 Present and Estimated Future Total Trips in Dar es Salaam

Year	Case		Walk/NMT	Public Transport	Ca/r Motor Cycle	Total
Y2017	Survey Result	1,000 Trips	3,456	4,540	756	8,752
		Share	39.5%	51.9%	8.6%	100.0%
Y2040	Case-0 D/N	1,000 Trips	6,567	10,189	2,399	19,155
		Share	34.3%	53.2%	12.5%	100.0%
		Growth Ratio	**1.90**	**2.24**	**3.17**	**2.19**
	Case-1 BRT Case	1,000 Trips	7,404	10,072	1,689	19,155
		Share	38.7%	52.6%	8.8%	100.0%
		Growth Ratio	**2.14**	**2.22**	**2.22**	**2.19**
	Case-2 M/P Case	1,000 Trips	7,404	10,211	1,540	19,155
		Share	38.7%	53.3%	8.0%	100.0%
		Growth Ratio	**2.14**	**2.25**	**2.04**	**2.19**

Source: JST

Based on the future public transport OD Matrix, a Transit Assignment was conducted. The transit assignment result was shown in Table 10.3.8.

- In Master Plan Case (Case-2), the share of Rail (MRT), BRT and buses was estimated as 3:3:4.

Table 10.3.8 Share of Total Public Transport

	Case-0 D/N Case		Case-1 BRT Case		Case-2 M/P Case	
Unit	1000 passenger*km	share	1000 passenger*km	share	1000 passenger*km	Share
Rail	13,412	9.0%	11,713	7.1%	56,444	32.8%
BRT	30,676	20.5%	51,065	30.8%	45,774	26.6%
Bus	105,546	70.5%	102,892	62.1%	69,835	40.6%
Total	149,634	100.0%	165,670	100.0%	172,053	100.0%

Source: JST

MRT and BRT section volume were shown in Table 10.3.9 (1) and (2). As transit assignment is daily base passengers, PHPDT was converted using present BRT peak ratio of 10%.

- Both MRT and BRT is expected to have high demand in 2040 even though both lines overlap along the same route.
- The MRT passenger volume will be about twice of BRT passenger volume at overlapped section.

Table 10.3.9 (1) Section Volume of Case-2 in 2040 (MRT)

Line	Section	No. of Passenger /day			PHPDT*
Loop Line	Central - Ubungo-Mwenge-Morocco	428,000	～	844000	42,200
Bagamoyo Line	Mwenge - Bunju	673,000	～	1,029,000	51,450
Morogoro Line	Ubungo - Kimara	912,000	～	1,113,000	55,650

*PHPDT: Peak Hour Peak Direction Traffic
Note: Assumption: peak ratio 10% (BRT Phase-1 147 bus/peak-h/dir. Total 1,357 bus/day/dir.)
Ref. present PHPDT in Phase-1 Section. Appx 15,000
Source: JST

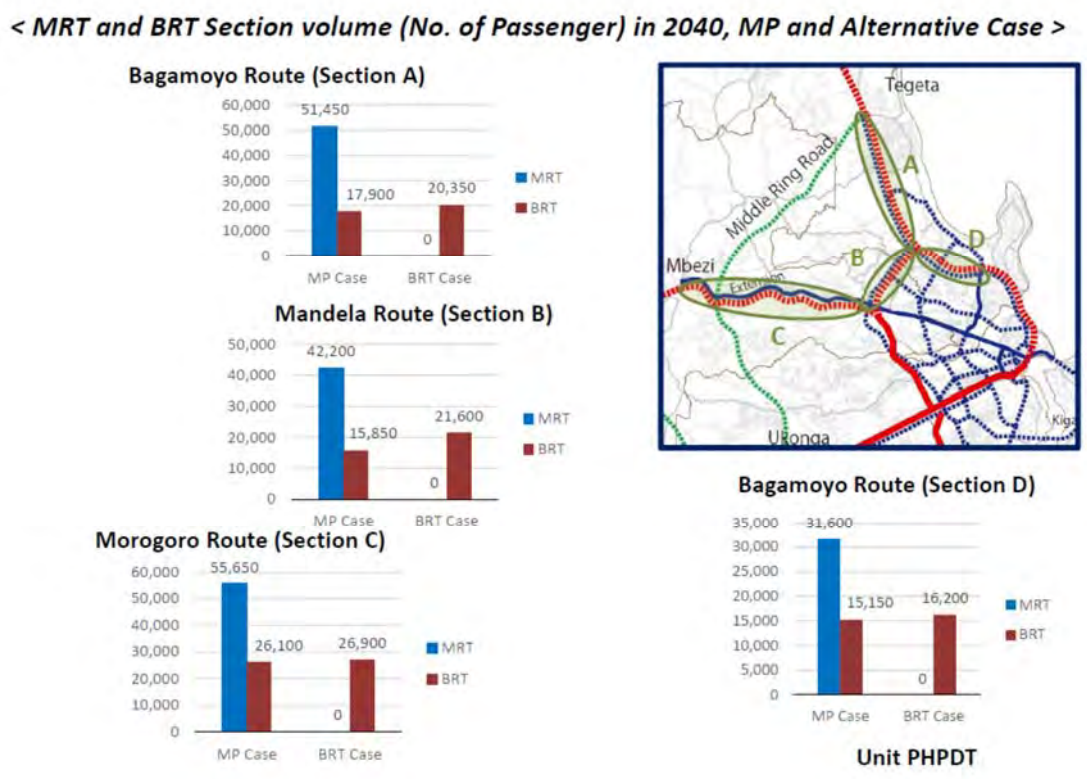
Table 10.3.9 (2) Section Volume of Case-2 in 2040 (BRT)

Line	Section	No. of Passenger /day			PHPDT*
Phase-1	Morogoro Rd	251,000	~	522,000	26,100
Phase-2	Kilwa Rd	229,000	~	470,000	23,500
Phase-3	Nyerere Rd	164,000	~	379,000	18,950
Phase-4	Bagamoyo Rd	276,000	~	358,000	17,900
Phase-5	Nelson Mandela Rd	160,000	~	317,000	15,850
Phase-6	Old Bagamoyo Rd	248,000	~	287,000	14,350

*PHPDT: Peak Hour Peak Direction Traffic
Source: JST

To identify the volume of the overlapped section, a comparison graph was illustrated in Figure 10.3.5.

- The volume of MRT passenger will be more than twice that of the volume of BRT passengers.
- Compared with BRT Case (Case-1), BRT PHPDT will not be reduced as much as expected. It is estimated that many MRT users may use also BRT going to their destinations because of the collaboration with station interval's difference. Transit assignment shows about half of MRT users will also use BRT in going to their destination.



Source: JST

Figure 10.3.5 PHPDT of Overlapped Section in Case-1 (BRT case) and Case-2 (M/P case)

Table 10.3.10 Estimated Travel Time

Route	From - To	Length (km)	Travel Time (min)	
			Case-1 BRT Case	Case-2 M/P case
Bagamovo	Bunju →CBD	33.1	147	57
Morogoro	Luguruni → CBD	28.2	107	59
Pugu	Pugu →CBD	18.7	65	45
Kilwa	Mbagala →CBD	13.8	41	41 (BRT only)

Assumption: average travel speed Bus 10km/h, BRT 20km/h and MRT 35km/h
Source: JST

M/P case can be achieved within one hour (60 min) from city boundary to CBD as shown in Table 10.3.10. M/P case can also achieve the following targets.

Table 10.3.11 Road Traffic Assignment Result

Indicators	unit	Case-0 D/N Case	Case-1 BRT Plan	Case-2 MP Case
Total Vehicle*km	1000 veh*km	19,472	20,944	16,867
Total Vehicle time	1000 veh.*hr	1,812	735	545
Ave. Volume / Capacity(V/C)		1.97	0.76	0.61
Ave. travel Speed	km/h	10.7	28.5	30.9

Source: JST

Comparison of the results of Case-1 and Case-2 showed the big impacts such as reduction of V/C (0.15 reduction) and travel speed of 2.4km/h up in the whole road network.

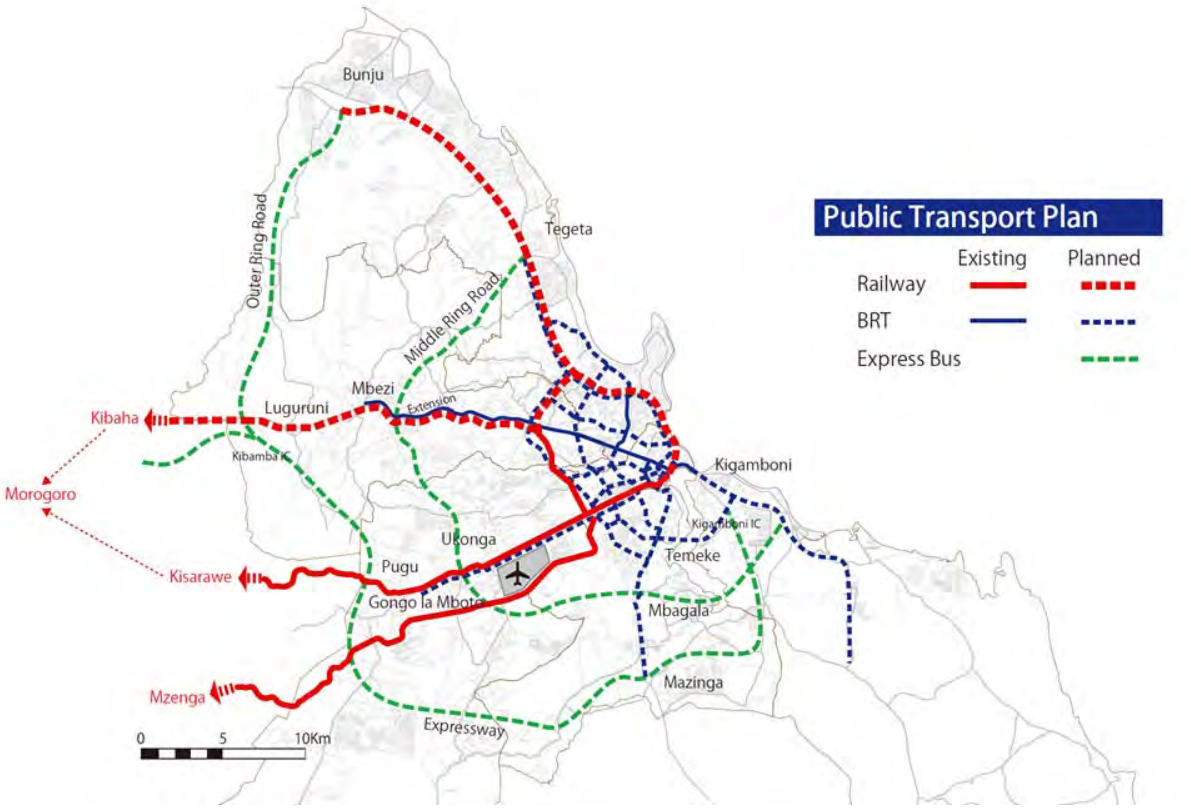
- Modal shift from private vehicle use to public transport use
- Convert from many buses to MRT

It shows that MRT projects also contribute to the mitigation of the road traffic congestion if they provide good public transport service to the users.

(3) Definitive Public Transport Plan

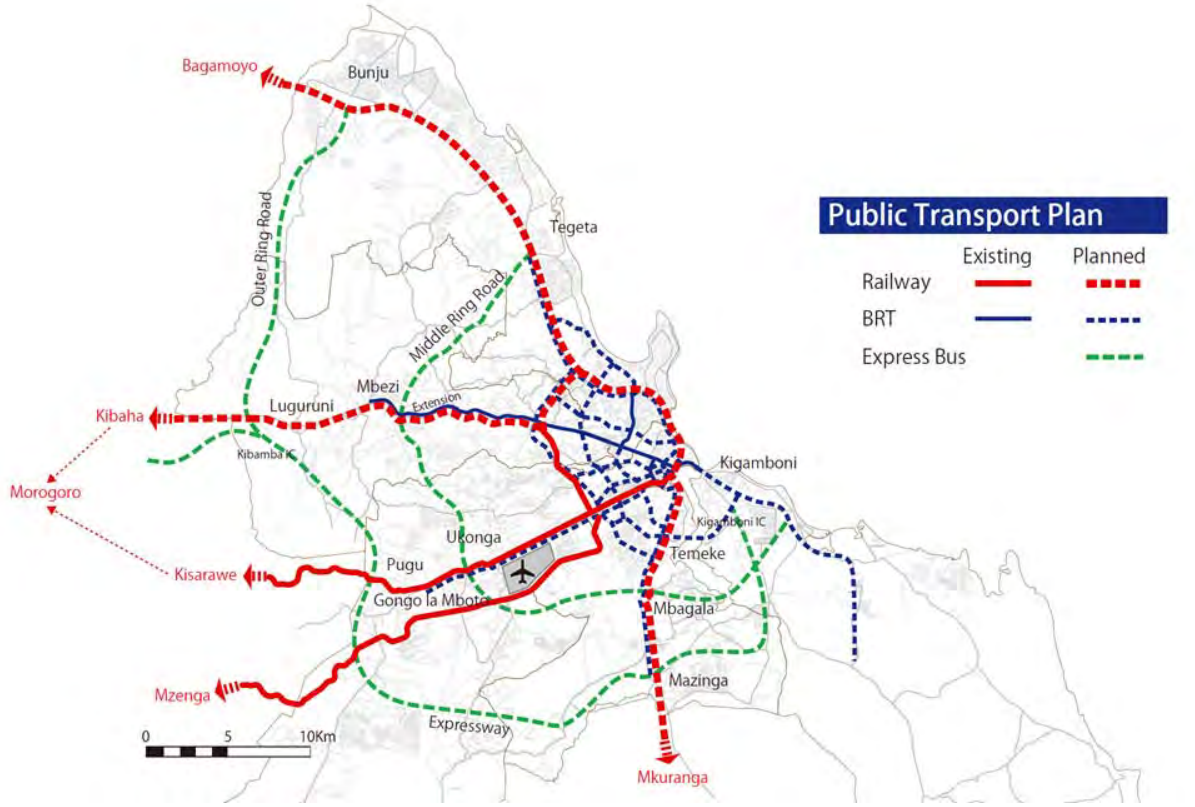
Above transport demand forecast results were shown that proposed Master Plan Case will be able to mitigate the future traffic congestion. MRT projects will have a big impact. The proposed public transport network is illustrated in Figure 10.3.6(1). Mainly the area 15km away from CBD will be covered by BRT. The areas over 15km away from CBD, such as suburban areas will be supported by MRT.

As railway projects should be considered in the long-term such as after the target year 2040, MRT projects to be considered should be Kilwa line and extension of other MRT lines, as illustrated in Figure 10.3.6(2).



Source: JST

Figure 10.3.6 (1) Future Public Transport Networks in 2040



Source: JST

Figure 10.3.6 (2) Future Public Transport Networks after 2040

10.3.3 Proposed New Railway Line

(1) Key to Realize MRT Development Plan

"The Project Research for the Urban Transport Plan" conducted by JICA in 2011 reported the best timing of MRT commencement in the viewpoint of the population and GDP per capita. Figure 10.3.7 indicates that MRT operation shall be commenced before 2025 in DSM. MRT is highly expected by those factors in DSM. On the other hand, MRT development is a very challenging project in Tanzania because of the high cost and as the first transport mode in the country. Therefore, several key items for development shall be considered in the early stage.

Source: The Research on Practical Approach for Urban Transport Planning, JICA, 2011

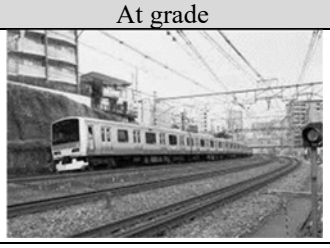
Figure 10.3.7 Forecast at Opening of Metro (Africa)

a) Cost Saving

The existing railway ROW is utilised to reduce the initial cost of MRT development. It is possible to develop at grade section (or on the embankment) within ROW. MRT structure of the other section will be the viaduct structure or underground structure because MRT route passes along/under the road.

In general, underground structure requires higher costs and takes a long construction period. One possible underground section is CBD area (seaside area) because the existing road in the centre of CBD (Indian St.) is too narrow (approx. 7m) to build the viaduct structure. Therefore, the route alignment at this section shall be carefully considered in the viewpoint of the construction, passenger convenience and cost. General comparison among three types of railway structures is summarized in the table below.

Table 10.3.12 General Comparison among Three Types of Railway Structure

	At grade	Viaduct	Underground
			
Cost	40-50 million USD/km	80-100 million USD/km	160-200 million USD/km
Disadvantage	Level crossings will be required	Occupy the median or sidewalk for pier construction	The ground above the station will be occupied during construction. Transition section shall be constructed by cut & cover method.

Source: JST

b) Coexistence with BRT

BRT Phase-1 project is the successful new transport mode in DSM and further development is expected. This includes construction of BRT-dedicated lines at the median of the road and reduction of road capacity.

On the other hand, MRT viaduct structure shall also be built at the median of the road for passenger accessibility. However, if the median is not available, it is possible to build the MRT viaduct structure at the sidewalk of the road where space is available. Road ROW shall be determined by considering the future MRT development.

Some part of proposed MRT corridor overlaps with BRT's further phase routes. Therefore, development strategy of the public transport shall be carefully considered to have BRT and MRT coexist.

(2) Future Demand of MRT Line

To identify the priority of MRT Line, future demand analysis was conducted. Mainly the four corridors such as Bagamoyo corridor, Morogoro corridor, Kilwa corridor and Loop corridor were studied. As Nyerere corridor has Pugu line as railway and it will be conducted as Track doubling project, a part of SGR project, Nyerere corridor was not included the study routes.

Table 10.3.13 Future Demand of MRT Line

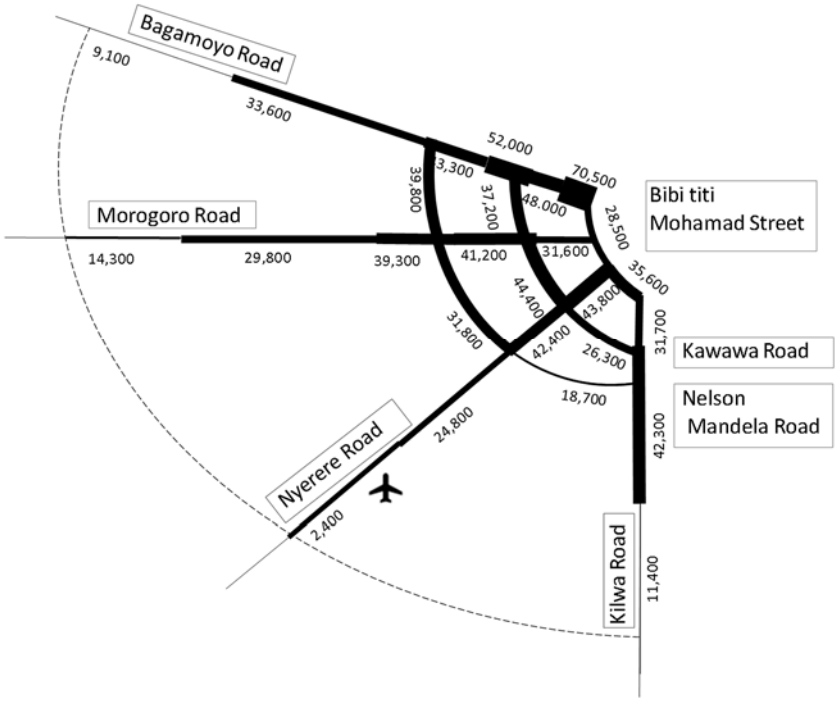
Corridor	Length	Section
1.Bagamoyo corridor	25km	Mwenge-Tegeta-Bunju
2.Morogoro corridor	26km	Ubungo-Kibaha
3.Kilwa corridor	15km	CBD-Vikindu
4.Loop corridor	27km	CBD-Tazara-Ubungo-Mwenge-Morocco-CBD

Source: JST

a) Present Traffic Congestion

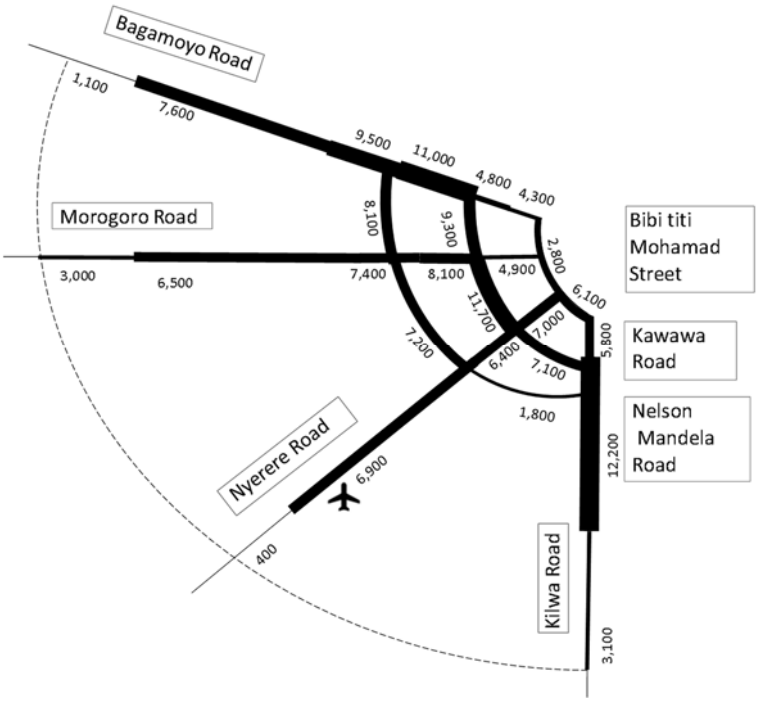
Figure 10.3.8 and Figure 10.3.9 illustrated the present traffic volume. The highest daily traffic volume was 70,500 at CBD-Morocco section of Bagamoyo Road. The suburban section of Bagamoyo Road also was seen with high volume, 33,600 vehicles per day.

The section of high public transport traffic (over 10,000 vehicles per day) is Bagamoyo Road, Kilwa Road and Kawawa Road.



Source: JST

Figure 10.3.8 Present Daily Traffic Volume (All Vehicles, 2017)

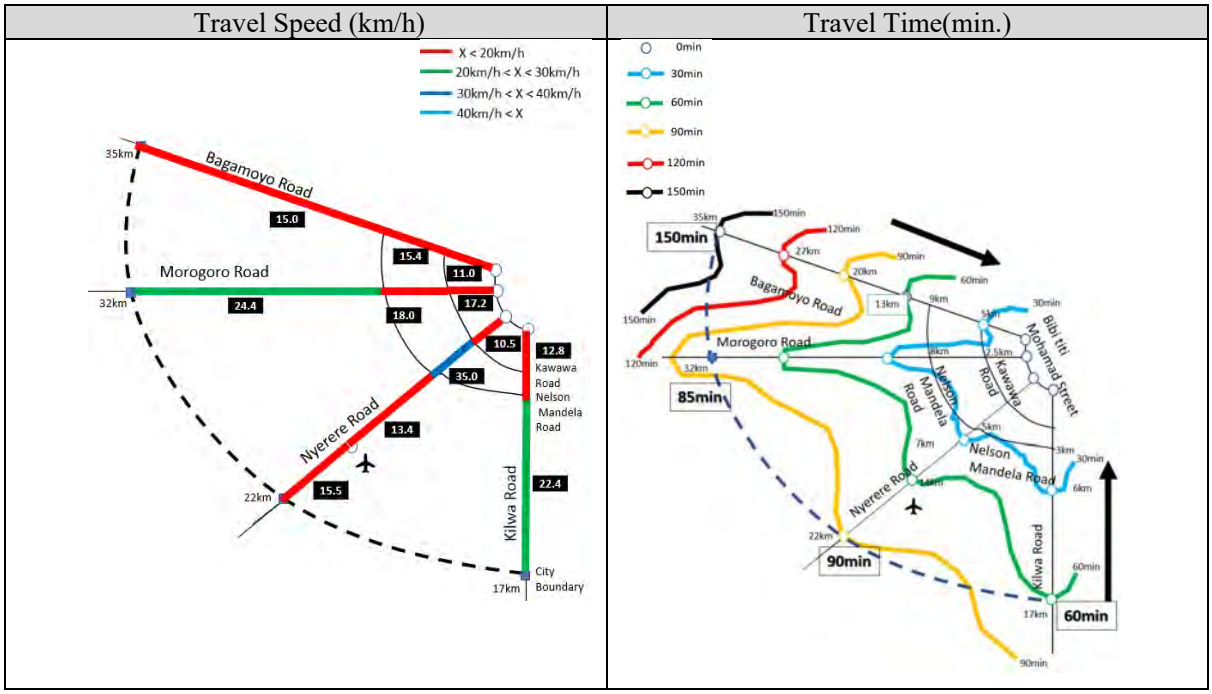


Source: JST

(Public transport: BRT+Bus+Daladala)

Figure 10.3.9 Present Daily Traffic Volume (Public transport, 2017)

Figure 10.3.10 illustrated the present travel speed and time. Among these trunk roads, Bagamoyo Road shows the heaviest congestion. It took approximately 2.5 hours in the morning from suburban area to CBD (inbound).



Source: JST

Figure 10.3.10 Present Travel Speed and Time in the morning peak, inbound (Suburb to CBD)

b) Future Demand Forecast

Table 10.3.13 shows the estimated passenger volume of each corridor in 2040. Morogoro corridor has the highest demand (MRT 55,650 PHPDT, BRT 26,100 PHPDT). Bagamoyo corridor also has high demand, and estimated demand along MRT is 51,450. Loop corridor's demand is 20% smaller than demand along Morogoro and Bagamoyo corridors. In 2040, Kilwa corridor was not considered to be a new MRT line, thus has no volume for MRT. As passenger demand along Kilwa is much smaller than other three corridors, new MRT will be needed after 2040.

Table 10.3.14 Passenger Volume of each route in 2040 (MRT, BRT)

corridor	MRT				BRT			
	No. of Passenger /day			PHPDT*	No. of Passenger /day			PHPDT*
Bagamoyo corridor	673,000	～	1,029,000	51,450	276,000	～	358,000	17,900
Morogoro corridor	912,000	～	1,113,000	55,650	251,000	～	522,000	26,100
Kilwa corridor	-		-	-	229,000	～	470,000	23,500
Loop corridor **	428,000	～	844000	42,200	160,000	～	317,000	15,850

*PHPDT: Peak Hour Peak Direction Traffic
** Loop corridor – BRT section volume is Phase-5 Nelson Mandela Rd.
Source: JST

c) Result

Based on the above study, the highest priority corridors are the Bagamoyo and Morogoro.

Bagamoyo Line

- Currently, Bagamoyo route has serious traffic congestion during peak hours. After construction of BRT Phase-4, road congestion of Bagamoyo road may be drastically alleviated, but high public transport demand will still be expected in the future. Bagamoyo line has high potential of urban development due to Bagamoyo EPZ development plan and many construction spaces for skyscrapers such as commercial, business and residential complex along Bagamoyo Road. Currently, Bagamoyo EPZ development plan is not considered in the future traffic demand model due to confidential information of EPZ plan.

Morogoro Line

- Morogoro Line has the highest demand route in the future and it also has high potential for increasing traffic demand along the Central Corridor route.
- As present BRT Phase-1's passenger demand is already near full capacity, it will be necessary to improve public transport system such as MRT construction project.

Kilwa Line

- Compared to the other two lines, demand will not be high. With the future urban development beyond Dar es Salaam city, Kilwa Line will be necessary after 2040.

Loop Line

- Loop Line will promote the development of sub-centres (Tagaza, Ubungo, Mwenge and Morocco) and it is the of connection among Bagamoyo, Morogoro Line and CBD area, so a part of Loop Line will be implemented at the same time as Bagamoyo and Morogoro Line. As the

Loop line advantage was described in section "(6) Loop Line Network and its advantage" later.

Table 10.3.15 Priority Rank

Corridor	Priority rank
1.Bagamoyo Corridor	1st
2.Morogoro Corridor	1st
3.Kilwa Corridor	3rd
4.Loop Corridor	2nd

(3) Staging Plan of New MRT Line

Based on the traffic demand forecast and public transportation network, loop line, Bagamoyo line and Morogoro line are needed in order to deal with the huge transportation demand in 2040 as shown in Figure 10.3.11. On the other hand, it is difficult to develop all lines at once due to the financing, construction period, implementation organisation, etc. JICA Study Team proposes the staging plan of MRT development in 2025 and 2030.

Source: JST

Figure 10.3.11 Proposed New MRT Line in 2040

a) MRT Network in 2025

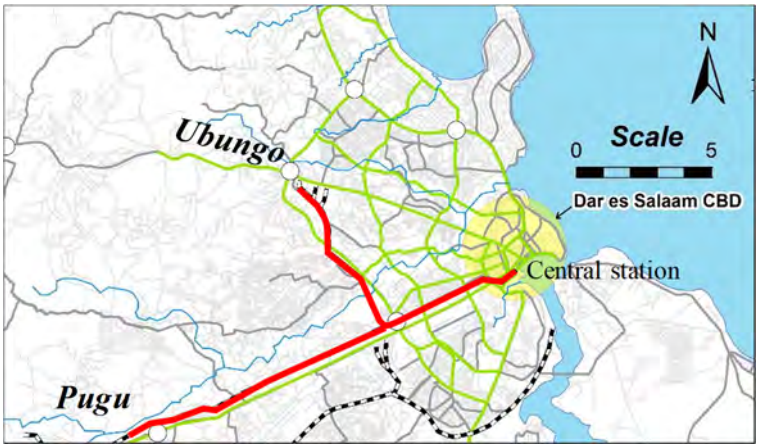
The key elements to develop the railway network in short-term are; cost minimization and land availability. If it is high-cost and land is not available, the project might not be completed until 2025. The following two plans are proposed:

- Track doubling of Pugu line: 20km
- Upgrade of Ubungo line: 11.7km

At present, Stander Gauge Railway (SGR) project Phase-1 has been implemented between Central Railway station and Morogoro station spanning 200 km although it is mainly used for freight train, commuter train can be operated between Central Railway station and Pugu station on a 20km long route. On-going SGR project is developed by single track with electrification, so JICA Study Team proposes another single track to be developed parallel with on-going SGR which is call "Track

doubling of Pugu line".

On the other hand, branch line between Central station and Ubungo station has not been planned to be upgraded even though there is high passenger demand. JICA Study Team proposes the development of electrified double track SGR for commuter train between Central station and Ubungo station in 11.7km long to form the half loop line together with on-going SGR project which is called "Upgrade of Ubungo line".



Source: JST

Figure 10.3.12 Proposed Railway Line in 2025

b) MRT Network in 2030

After upgrade of the existing lines, the following three lines shall be developed in parallel to one another:

- Tegeta ~ Aga Khan: 21.7km
- Ubungo~ Mbezi: 11.5km
- Ubungo ~ Mwenge: 4.5km

Tegeta ~ Aga Khan Section is the most important section because of high demand and no public transportation service section at present. In addition, road congestion along Bagamoyo Road and Ali Hassan Mwinyi Road is serious due to the low road capacity, so it is expected to reduce the current road traffic by modal shift. It is possible to transport the huge demand from Tegeta area to Aga Khan area efficiently.

Mbezi ~ Ubungo section has approximately 40km long to access CBD through loop line. Nevertheless, this section is also important to transport the huge demand from Kibaha area to CBD. Road width of this section is wide enough for MRT development, even though BRT Phase-1 is running in parallel.

Ubungo ~ Mwenge section is kind of the missing link between existing line and new developed lines, therefore this section is also important to form the loop line in the early stage.

Source: JST

Figure 10.3.13 Proposed Railway Line in 2030

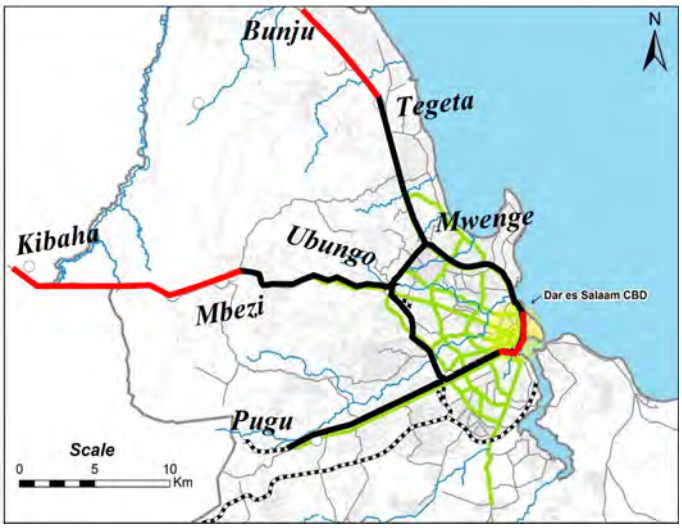
c) MRT Network in 2040

The following supplemental MRT network is proposed to form the loop line and extension of urban area:

- Aga Khan ~ Central station: 4.5km
- Tegeta ~ Bunju: 13km
- Mbezi ~ Kibaha: 14.5km

Although tunnelling work is very challenging due to the high cost and long construction period, the construction between Aga Khan and Central station is necessary to form the loop line and to realise the transportation master plan in 2040. Re-development is also required to construct the underground station accordingly, since CBD area is too narrow to construct the underground station by cut and cover method.

Extension from Tegeta to Bunju is planned to meet the future population expansion of suburban areas.



Source: JST

Figure 10.3.14 Proposed Railway Line in 2040

d) MRT Network After 2040

After 2040, the following MRT plan is proposed, but it should be reviewed and revised based on the actual population growth and traffic demand in the next revision of the transportation master plan.

- Kilwa line
- Bagamoyo extension
- Morogoro extension

Source: JST

Figure 10.3.15 Proposed Railway Line after 2040

(4) Implementation Plan

Figure 10.3.15 shows the realistic implementation schedule as a view point of preparation and construction period. As for the financial aspect, although annual payment attempts s to coordinate with the construction schedule, high project costs shall be required in each year.

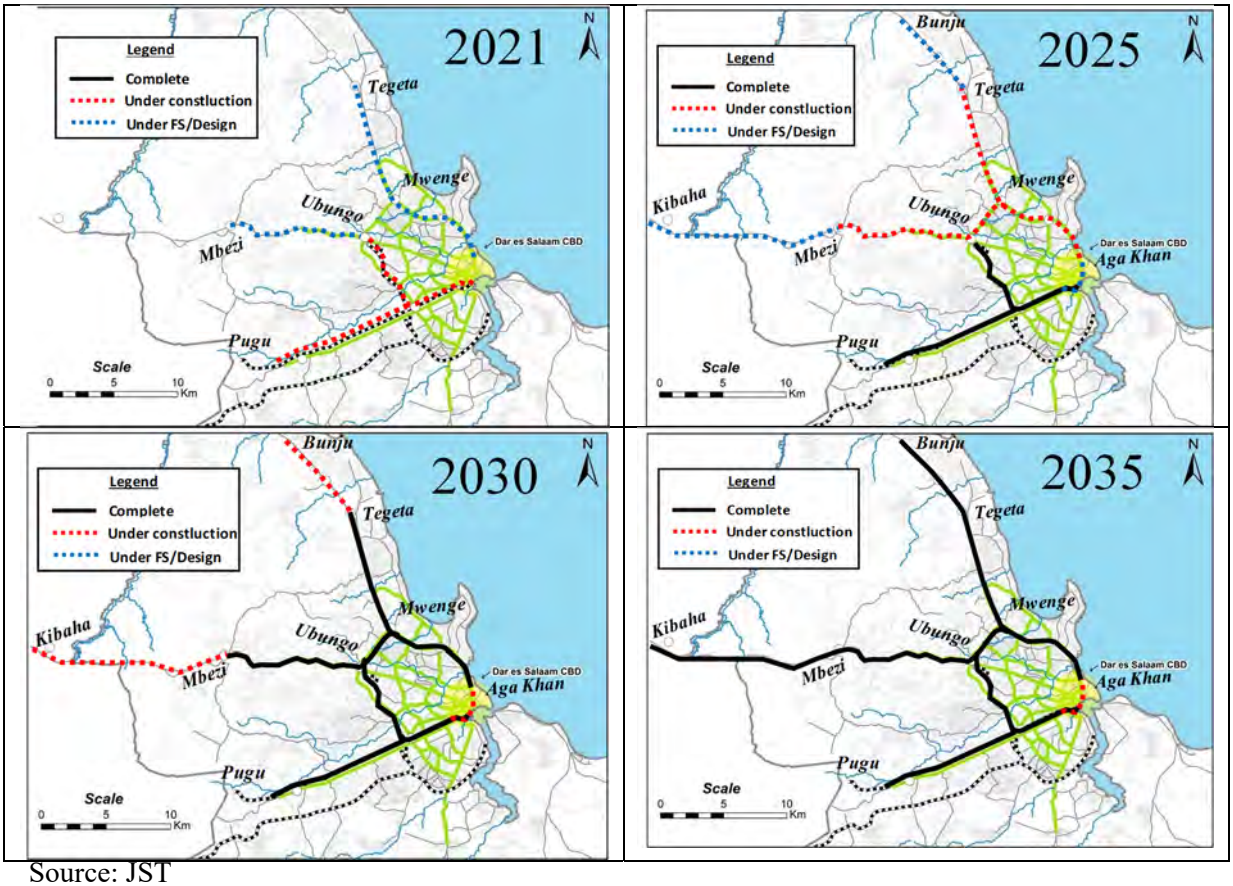
Tegeta line is the first priority new line and the preparation shall be started now. After confirmation of the feasibility and design of Tegeta line has been started, feasibility study for extension between Mwenge and Ubungo shall be started. Construction completion year is the same for both lines. Coordination between Morogoro line and extension between Mwenge and Ubungo is also required during the study and design stage.

After completing the construction of Tegeta line, the construction of extension lines from Tegeta to Bunju and from Aga Khan to Central station shall be started. All lines are to be opened sequentially. Time frame figures are shown in Figure 10.3.16.

		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
1	**Upgrade of Ubungo line (CBD-Ubungo)**																							
1-1	FS/ Design																							
1-2	Procurement																							
1-3	Construction																							
1-4	Commissioning																							
2	**Track doubling of Pugu line (CBD-Pugu)**																							
2-1	FS/ Design																							
2-2	Procurement																							
2-3	Construction																							
2-4	Commissioning																							
3	**Tegeta Line (Tegeta~Aga Khan)**																							
3-1	MP/Pre Feasibility Study																							
3-2	Feasibility Study																							
3-3	Detail Design																							
3-4	Procurement																							
3-5	Construction																							
3-6	Commissioning																							
4	**Extension line between Mwenge and Ubungo**																							
4-1	Feasibility Study																							
4-2	Detail Design																							
4-3	Procurement																							
4-4	Construction																							
4-5	Commissioning																							
5	**Morogoro Line (Ubungo ~ Mbezi)**																							
5-1	Feasibility Study																							
5-2	Detail Design																							
5-3	Procurement																							
5-4	Construction																							
5-5	Commissioning																							
6	**Extension line between Aga Khan and Central**																							
6-1	Feasibility Study																							
6-2	Detail Design																							
6-3	Procurement																							
6-4	Construction																							
6-5	Commissioning																							
7	**Extension line between Tegeta and Bunju**																							
7-1	Feasibility Study																							
7-2	Detail Design																							
7-3	Procurement																							
7-4	Construction																							
7-5	Commissioning																							
8	**Extension line between Mbezi and Kibaha**																							
8-1	Feasibility Study																							
8-2	Detail Design																							
8-3	Procurement																							
8-4	Construction																							
8-5	Commissioning																							

Source: JST

Figure 10.3.16 Proposed Implementation Schedule



Source: JST

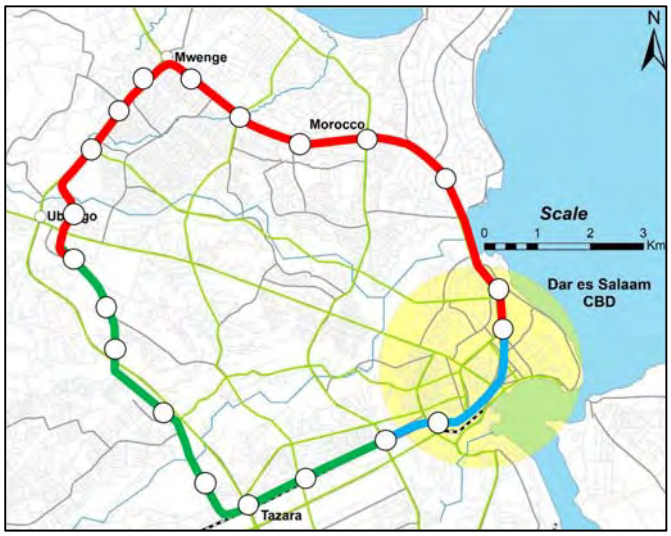
Figure 10.3.17 Time Frame Figures

(5) Loop Line Network and Its Advantage

a) Outline

Loop line as Circular MRT line is proposed as an alternative public transport network to transport the high demand of passengers. This idea is well coordinated with the land use plan which will develop the sub-centres at Mwenge, Ubungo and Tazara. It is possible to connect each sub-centre and CBD by the loop line and it can also promote the development of sub-centres accordingly.

Railway network shall be connected with BRT lines to enhance the accessibility and convenience for public transport passengers. In general, loop network connects the radial network, and the proposed loop line can also connect the existing four stations of BRT Phase-1. Next BRT phases are now under design stage and further development is expected to connect the loop line.



Source: JST

Figure 10.3.18 Proposed Loop Line

b) Example of the Loop Line Network

In Tokyo, Circular Railway (named Yamanote Line) was partially operated by Japan Railway from 1885 and full loop line has been operating since 1925. The number of stations is 29 and total operation length is 34.5 km at present. Average operation time is approx. 60 min. Tokyo is well known as railway developed city, and Yamanote Line is one of the important railway lines. It is because there are many transit stations with other lines and connecting the several sub-centres to each other. Although the development level of maturity of the public transport is different between Tokyo and DSM, the function of the circular railway network is similar to each other.

In Moscow, three radial railways which is connecting at the centre were developed at first, however many passengers must be gathered at the centre for transit. Under the circumstances, Loop Line was partially operated from 1950 and has been fully operating since 1954. Total operation length is 19.4 km and all 12 stations are transit stations with other lines. It contributes to relieve the congestion at the centre until today. Development circumstances of the circular railway are slightly different to the DSM case; however, it is one of the most successful public transport network developments in the world.

Source: Moscow Metro Company

Figure 10.3.19 Railway Network in Moscow

10.3.4 BRT Plan

Staging and implementation plan of BRT based on the current DART plan will be shown in Table 10.3.14. As Phase-2, 3 and 4 secured the project fund from WB and AfDB, DART will be implemented in short-term.

The alignment of Phase-5 and 6 might be revised later but it will be conducted in the medium-term. Phase-7 will be implemented with the progress of Kigamboni urban development. Figure 10.3.19 illustrates the BRT Route map.

Table 10.3.16 BRT Staging Plan

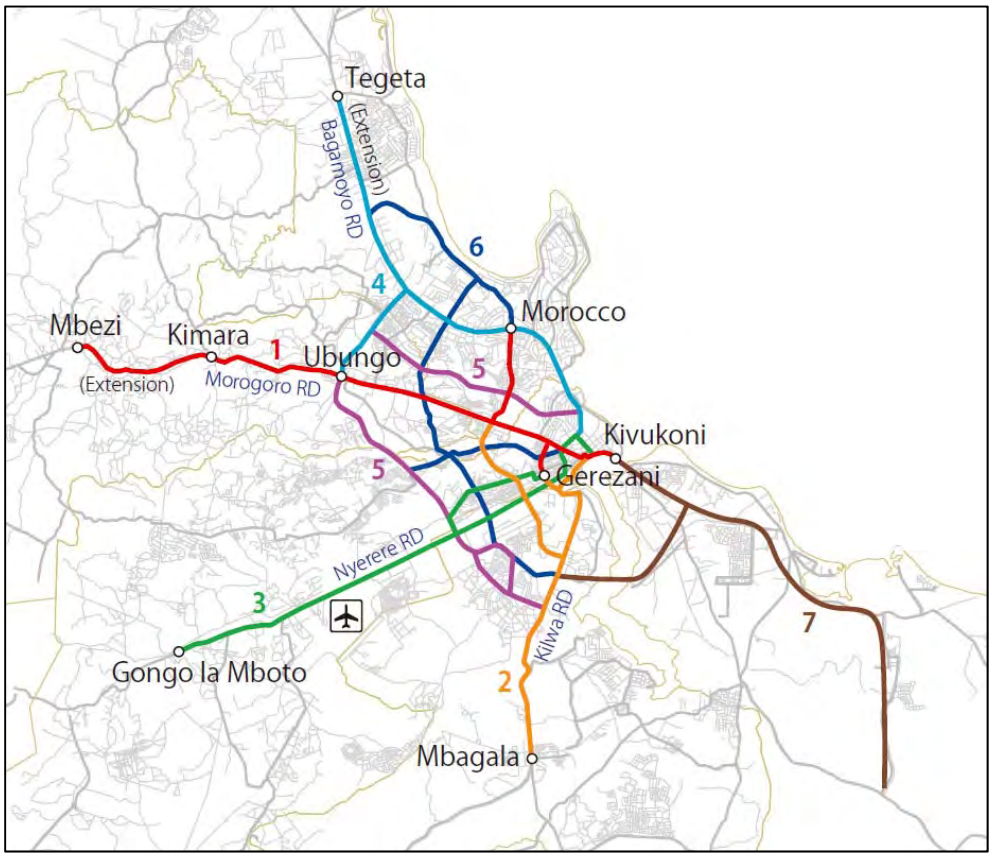
BRT Staging Plan
Short Term (2018~ 2025) - Phase-1 extension - Phase-2 - Phase-3 - Phase-4
Medium Term (2026~ 2030) - Phase-5 - Phase-6
Long Term (2031~2040) - Phase-7 (Kigamboni Route)

Table 10.3.17 BRT Implementation Plan

Phase	Road Corridor	Operation year	Fund
1	Morogoro	2016 (Completed)	WB
1 extension	Morogoro (Kimara to Mbezi)	Before 2025	Not yet decided
2&3	Kilwa Road, Nyerere Road	2020 (DART Plan)	AfDB (Phase2), WB (Phase3)
4	Bagamoyo Road, Sam Nujoma Road *Bagamoyo route will be extended up to Tegeta*	2022(DART Plan)	WB

5	Nelson Mandela Road, etc.	Before 2030	Not yet decided
6	Old Bagamoyo, etc.	Before 2030	Not yet decided
7	Kigamboni (proposed)	Before 2040	Newly proposed by JST

Source: JST



Source: JST

Figure 10.3.20 BRT Route Plan

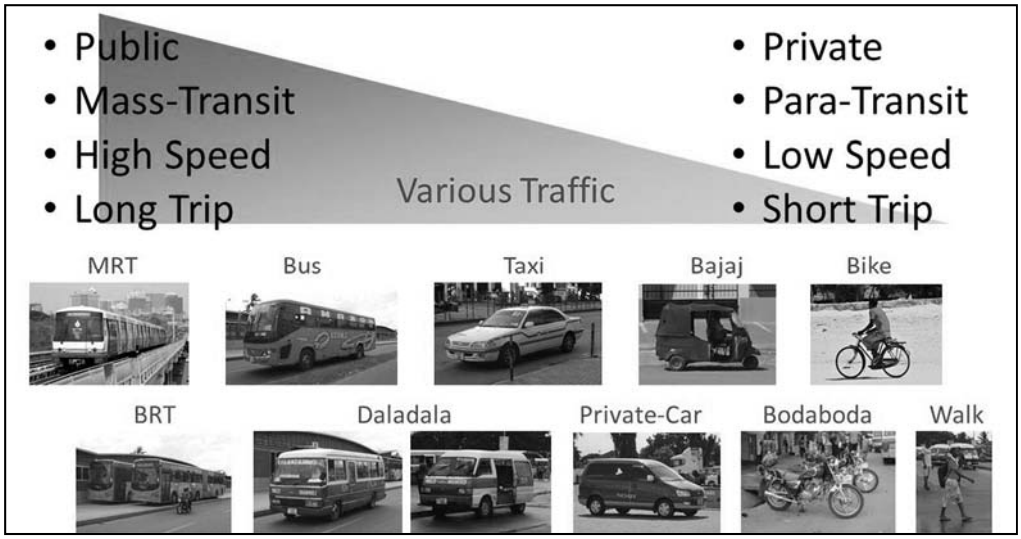
10.3.5 Transport Terminal Plan

(1) Definition of Transport Terminal

The transport terminal is planned based on the following considerations:

- The future public transport network will be composed of multiple layers such as MRT, BRT, etc., which have different functions (capacity, speed, trip length etc.).
- It is reasonable for users to combine various transport systems according to their needs.
- Terminals are facilities used to transfer safely, comfortably, and efficiently among different types of transport.
- The terminal also has the role of developing the district centre of the city.

Terminal has a function of connecting various traffic modes.



Source: JST

Figure 10.3.21 Image of Transport Terminal Function and Role

(2) Transport Terminal Type

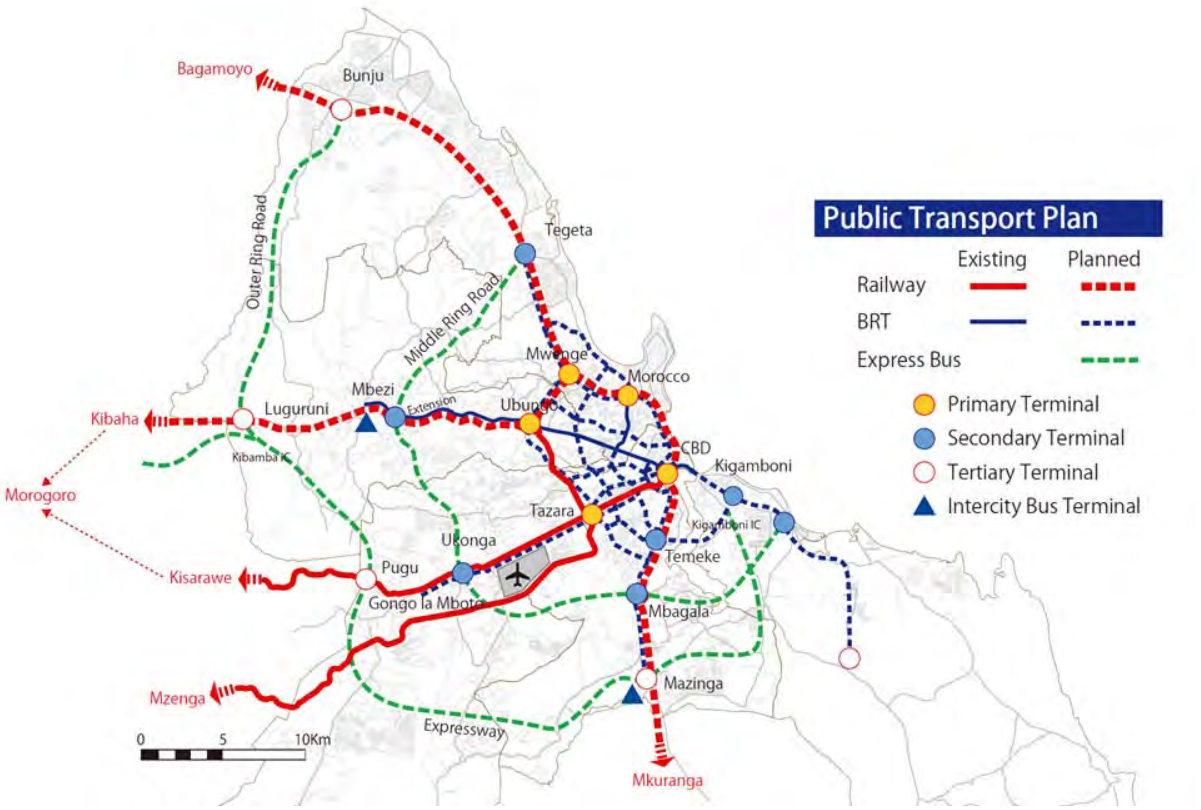
In the study, mainly three types of terminals are proposed with the size of urban area. Primary Terminal is located at CBD or sub-centre, and Secondary or Tertiary Terminals are located at satellite cities. Bus Terminal is located away from MRT and BRT stations, but it will be connected to many buses and/or paratransit.

Table 10.3.18 Proposed Types of Transport Terminal

Type	Role of Terminal	Main Function of Connecting	Location
Primary Terminal	To guide the development of City Centre in DSM. To secure the mobility in City Centre by the smooth transit among MRT, BRT and others.	• MRT • BRT ⟷ • MRT • BRT etc.	CBD Sub Centre
Secondary Terminal	To guide the development of centre in suburban area. To secure the smooth access from suburban area to MRT or BRT station.	• MRT • BRT ⟷ • Bus • Taxi, Private car (P&R, K&R) • Para transit	Satellite City
Tertiary Terminal	To secure the smooth access from suburban area to MRT or BRT station. To support secondary terminal.	⟷ • Private car • Para transit	Small Satellite City
Bus Terminal	To secure the smooth access from suburban area to Buses.	• Bus ⟷	Away from MRT, BRT
Intercity Bus Terminal	Departure and arrival point of long distance buses.	• MRT • BRT ⟷ • Intercity bus	Enough Space Suburb

Source: JST

(3) Proposed Transport Terminal



Source: JST

Figure 10.3.22 Proposed Transport Terminal Location Map

(4) Image of Transport Terminal Layout

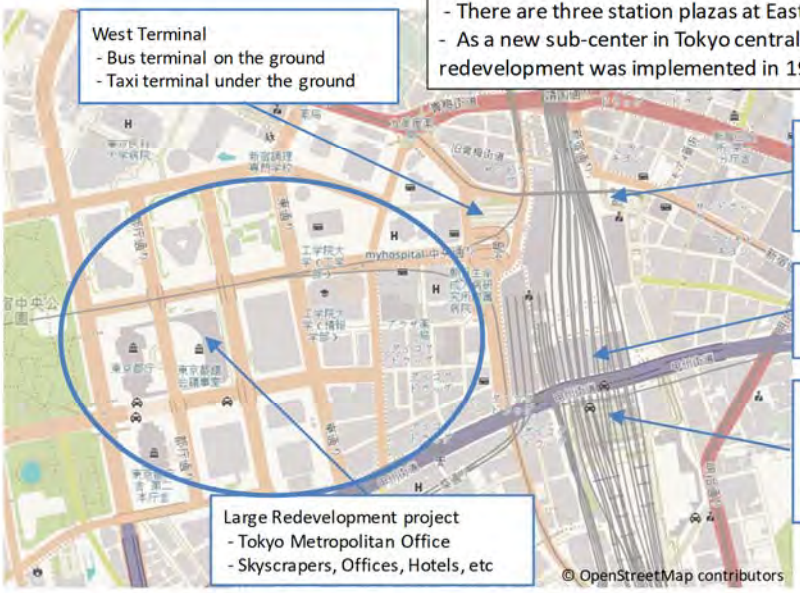
Image of transport terminals are shown in Table 10.3.16. With the urban development of sub-centre or satellite city, it will be necessary to develop the transport terminals such as redevelopment project, the developments of railway terminal, station building, station square, bus terminal, car and bicycle parking area.

To avoid additional cost to public transport operators, transport terminal will be developed as PPP (Public Private Partnership) scheme since many people gather at terminal and it is attractive for commercial business developers.

Table 10.3.19 Image of Transport Terminal

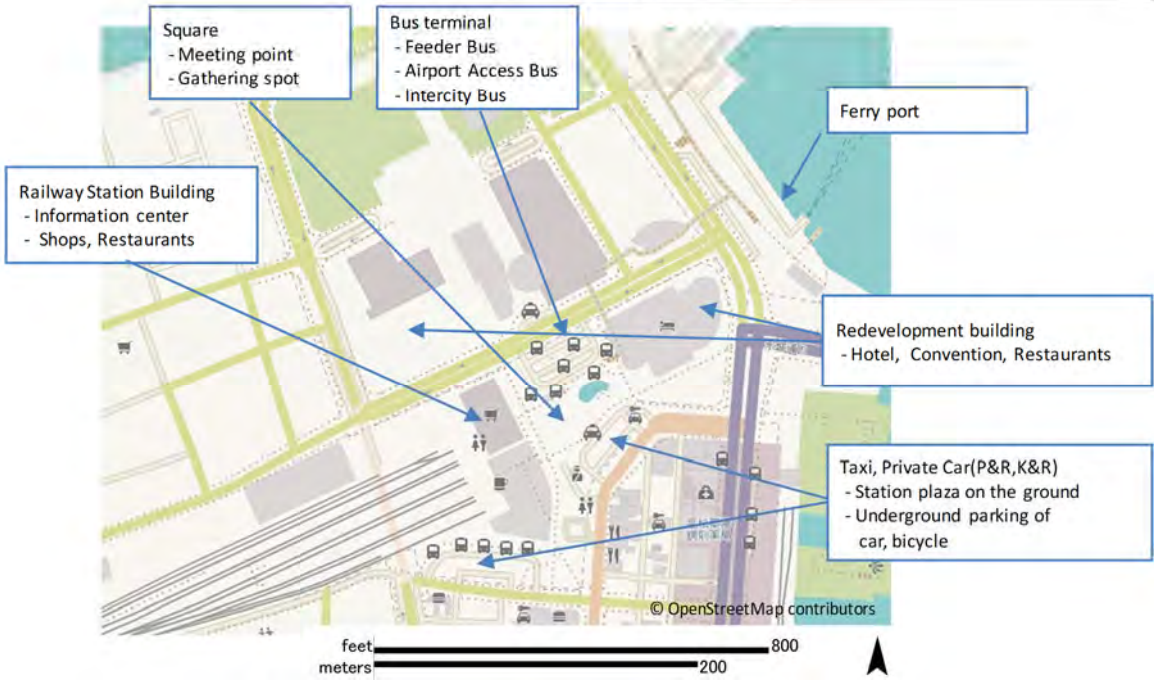
Primary Terminal (Large Scale)

Example 1 : Shinjuku Station in Japan
- Shinjuku station, the most congested in the world, is a railway terminal connecting many rail lines including subways.
- There are three station plazas at East, West and South gate.
- As a new sub-center in Tokyo central area, a huge scale redevelopment was implemented in 1970's.



Primary Terminal (Middle Scale)

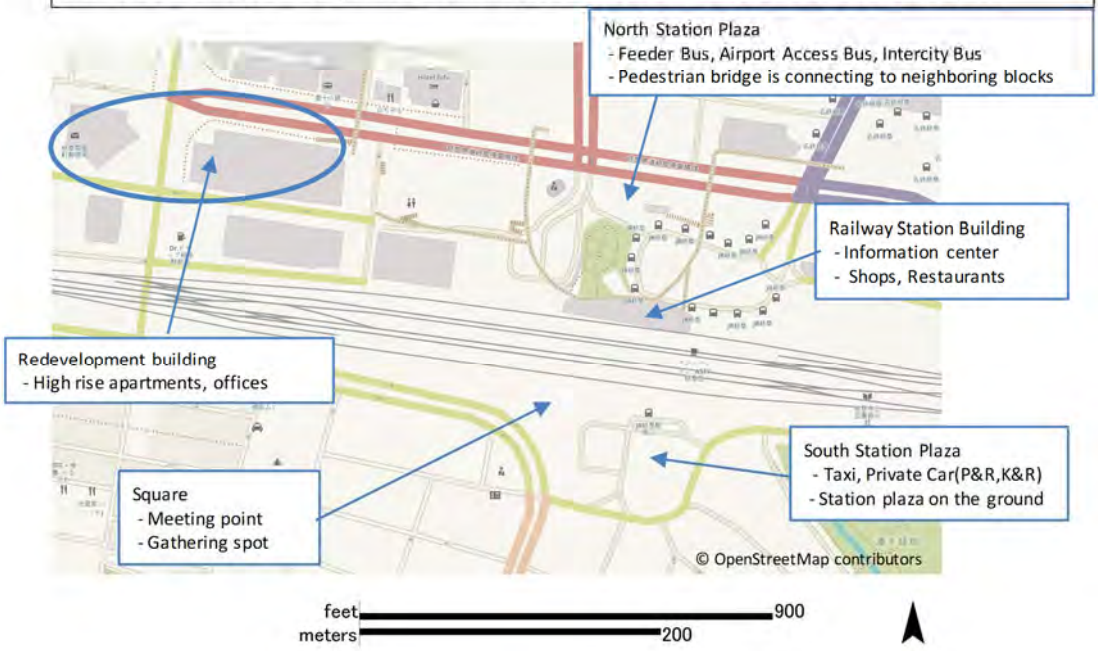
Example : Takamatsu Station in Japan
- A famous redevelopment project including the developments of railway terminal, station building, station square, bus terminal, connection to ferry port, hotels, offices, shops, restaurants etc.



Secondary Terminal

Example : Gifu Station in Japan

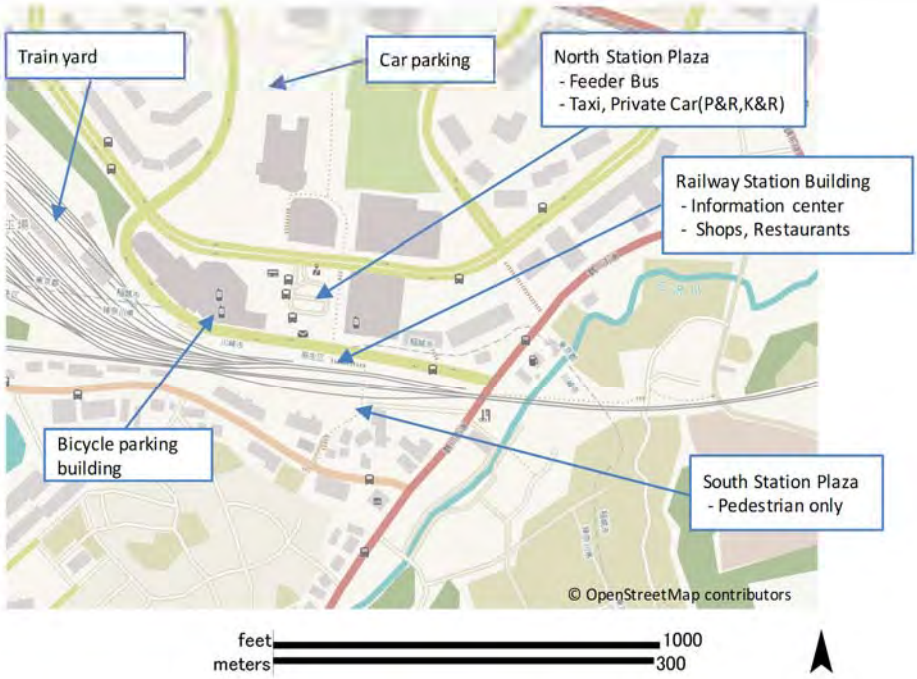
- Gifu station located 40km away from Nagoya station is one of commuter train terminal. Nagoya is one of major metropolitans in Japan. Gifu city is one of satellite cities in suburb of Nagoya.
- Gifu station area has been developed with very big station squares on both sides of North and South. Near the station there are high rise apartments for commuters like Toyota Corporation employees.



Tertiary Terminal

Example : Wakabadai Station in Japan

- Wakabadai station located 25km away from Shinjuku station is one of commuter train terminals in a big new town of Tokyo's suburb.
- Wakabadai station has a great number of car parking and bicycle parking lots for P&R. Many commuters to Shinjuku are living around the station.



Source: JST

10.3.6 Feeder Bus Plan

(1) Concept of Feeder Bus Operation

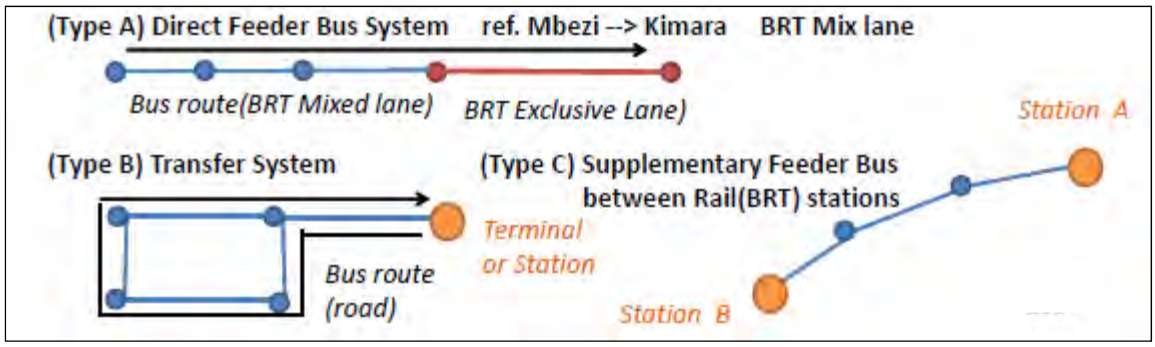
With the development of Railway (MRT) and BRT, the improvement of feeder bus service is essential, especially for suburban areas, in order to improve the accessibility. Feeder bus service is strongly related with the development of collector road network, since most feeder buses will run along the collector roads, which are two-lane paved roads in the future. Based on the target road density, total road length in the future will be 627km.

Table 10.3.20 Target of Road Density and Road Length in Dar es Salaam

Area	Target Road Density	Target Paved Road Length
Inside Nelson Mandela	4km/km^2 or more	74km
Nelson Mandela to Middle Ring Road	2km/km^2 or more	177km
Middle Ring Road to Outer Ring Road	1km/km^2 or more	376km
	Total	**627km**

Source: JST

Mainly the following three kinds of bus route systems will be proposed in Dar es Salaam. Feeder bus target speed is more than 15km/h and has fully covered the residential area in Dar es Salaam.

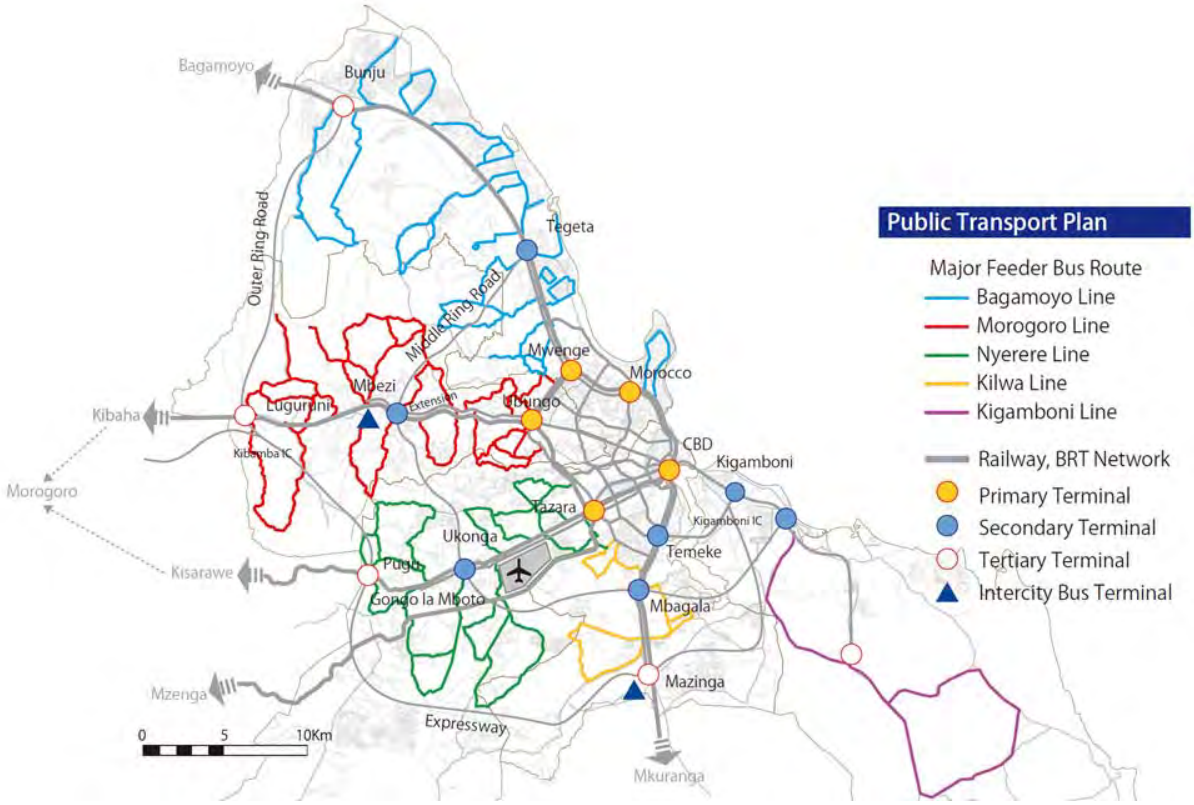


Source: JST

Figure 10.3.23 Proposed Feeder Bus Route System

(2) Feeder Bus Route

Figure 10.3.23 shows the image of major feeder bus routes in 2040. Feeder route will be connected to at least the terminals or MRT/BRT stations. Actual feeder bus routes will be determined with the collector road development, bus demand, etc.



Source: JST

Figure 10.3.24 Image of Feeder Bus Route System

10.3.7 Waterway Transport Plan

The waterway transport route in Dar es Salaam is operated from/to Kigamboni-CBD and Zanzibar-CBD. The candidate waterway transport is connected to the northern area and CBD.

(1) Previous Waterway Transport Study

In 2013, the following Pre-Feasibility Study was conducted by PO-RALG. The Pre-FS concluded that the project is not economically feasible.

Introduction

The Pre-Feasibility Study along the coast line from Mbweni to Kivukoni terminal, with a distance of 9.26km, started from February to June 2013. The route comprises of the seven terminals along the coastal line (see figure A).

Objective

Due to the forecasted increase in population from four million in 2015 to 5.8 million in 2030 and increased congestion along Bagamoyo Road, it was necessary to find the possibility for water way transport from Mbweni to Kivukoni.

Methodology

The study team conducted interview survey with public transport users in Mbweni and other areas along the coast as well as experienced marine transport operators. Basically, in achieving their results, they did SWOT analysis as well as financial and economic analysis to understand the feasibility of the project.

Findings

- Coast line is shallow and tide change is about 4m, hence making building of landing Piers costly. Landing Piers were observed to be 500m to 1,000m in some places.
- Compared to other transport modes, marine transport has higher cost in Dar es Salaam (reason; Cost Per Passenger-km is high for marine transport compared to other transport modes.)
- Higher fare for Marine transport and introduction of BRT system along Mwai Kibaki Road would reduce demand; the importance for the mode will not be realised.
- Maximum speed of ferry boat is 12-14 knots (22.224km/hour-25.928km/hour) which is slow and takes a long travel time of 1.5 hours to complete a single trip.

Recommendation

1. Subsidy during the 1st year of operation would be MUSD 0.9-1.2 per vessel. Fare rate will be TZS 750/Passenger.
2. Vessel capacity is 200-500 passengers per trip. Approx. 400-2000 passengers per day will be served.
3. Four single trips will operate daily, with two ferry boats with the capacity of 400 passengers per day
4. The government should tender the route among experienced local operators; TPA should invest in ramps and sailing routes.
5. There is a need to have a transport authority that will ensure coordination and integration of long-term planning and daily services. Intermodal transport is highly emphasised and encouraged.
6. There is a need for ferry operators to consider extending the route from Kivukoni to the inside of the harbour up to the north.

Figure A Proposed ferry

Conclusion

In conclusion, a service with six scheduled stops will require a total investment of 3.6 million USD in total.

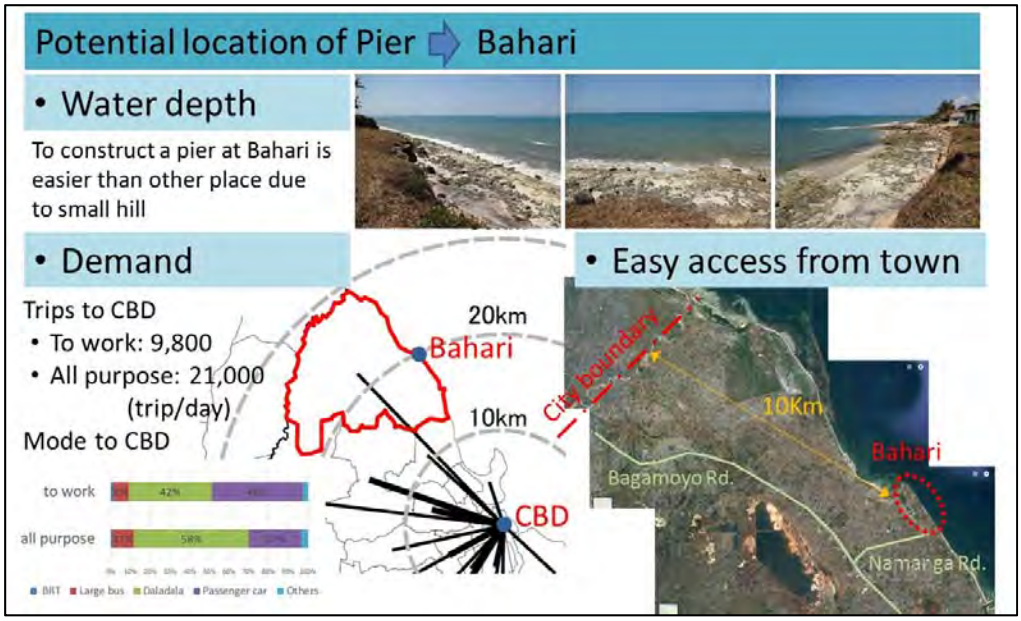
Based on the calculated EIRR of -20, during the analysis, all transport users'´gains in travel time and reduced driving costs are not likely to be sufficient to cover the purchase of ferries, costs of operations, ramps and land. Therefore, the proposed ferry service is not economically feasible.

(2) JST Proposed Watering Transport Plan

As mentioned in the above report, there are many issues, especially with proposed ramp stations. JST members conducted site survey along the north beach and has found the candidate location.

Based on observation, the candidate location of pier is identified as Bahari (see Figure 10.3.24).

- Easy to construct the pier
- High demand potential
- Easy access from town

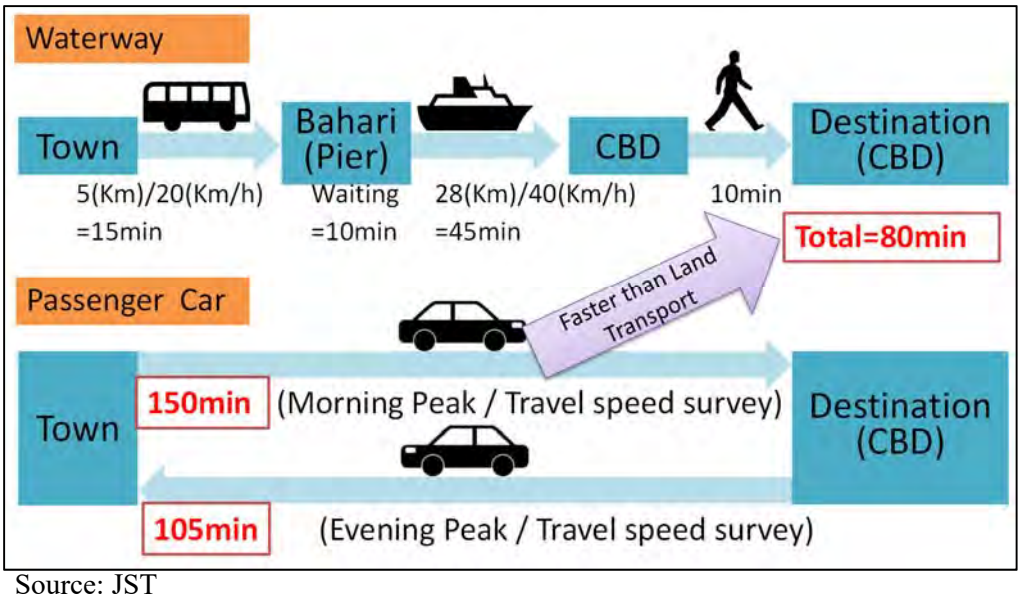


Source: JST

Figure 10.3.25 Proposed Bahari Pier Station's Advantage

Based on the estimate travel time from town of city boundary to CBD, travel time of waterway transport is much shorter than land transport shown in Figure 10.3.25. Assumption of ferry speed is 40km/h and ferry capacity is approximately 400-500 passengers as shown in Table 10.3.1.8

Proposed waterway transport is from/to Bahari and CBD directly and the extension of Bagamoyo will be proposed if Bagamoyo and Dar es Salaam traffic demand increases in the future as shown in Figure 10.3.26.



Source: JST

Figure 10.3.26 Proposed Watering Transport Route

Source: JST

Figure 10.3.27 Proposed Watering Transport Route

Table 10.3.21 Example of Ferry Speed and Capacity

	Distance (km)	Time (min)	Speed (km/h)
Dar es Salaam <500passengers> (Dar es Salaam – Zanzibar)	80	120	40
San Francisco <400passengers> (Vallejo – San Francisco)	45	60	45
New York <400passengers> (Midtown – Belford)	38	55	41

Source: JST

(3) Waterway Transport Plan Conclusion

Bahari to CBD route is one of the candidates for waterway project shown in Figure 10.3.26 with an estimated project cost of 23.2 million USD.

Table 10.3.22 Estimate Project Cost (Bahari- CBD Waterway Transport)

Two Ferry Boats purchase	13.0 million USD
Two Piers construction and Land Acquisition	10.2 million USD
Total Initial Cost	**23.2 million USD**

Source: JST

It is necessary to conduct a feasibility study to verify the estimated project cost; O&M cost, economic and financial viability.

BRT Phase-4 (Bagamoyo route) will be completed in 2022 according to DART Plan. If the operation of BRT Phase-4 will be delayed, the priority of waterway transport will become high.

10.3.8 Public Transport Project List

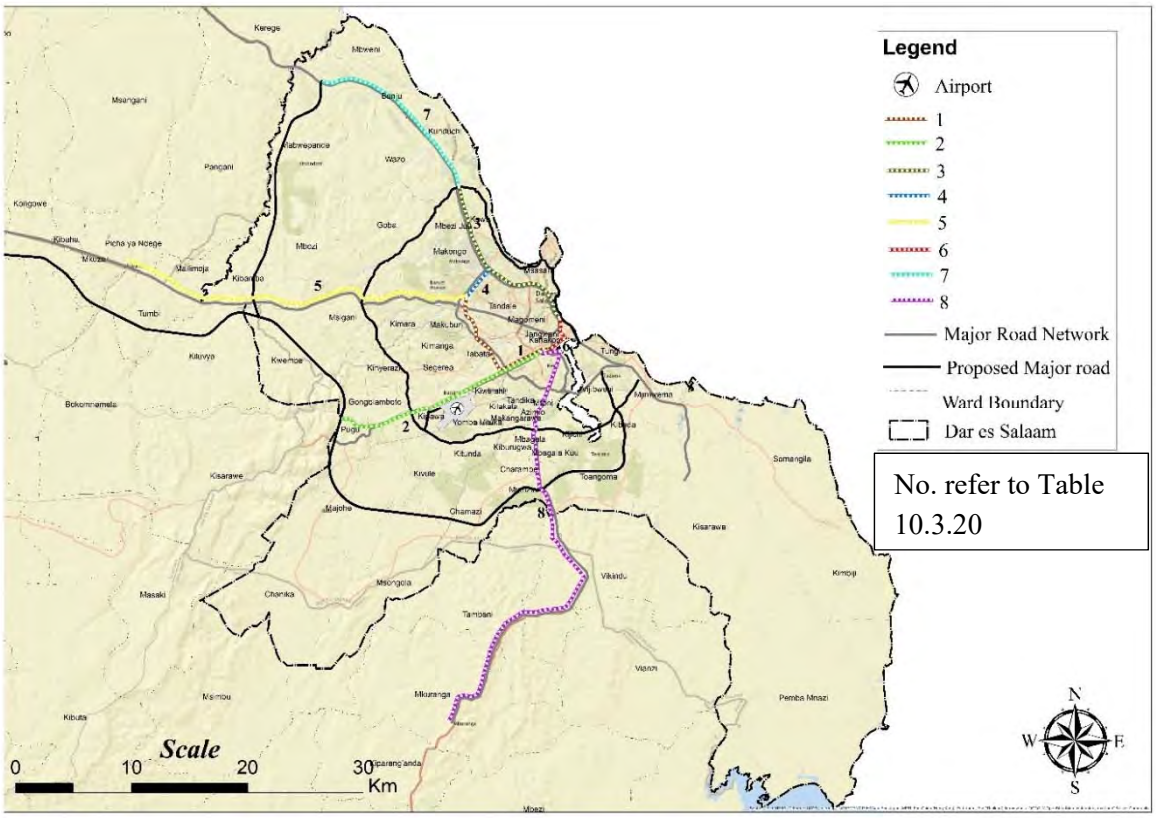
Public transport plan was summarized as project list. Construction cost of railway (MRT) project includes civil structure, rolling stock, E&M, signal and telecommunication cost.

(1) Railway (MRT) Project

Table10.3.23 Railway (MRT) Proposed Project List

No	Name of Project	Length Area	Section Place	Term	Construction Cost (Billion TZS)	Implementation Body	Notes
1	Upgrade of Ubungo line	11.7km	CBD-Ubungo	Short	461	TRC	New double track line along the existing line
2	Track doubling of Pugu line	20km	CBD-Pugu	Short	514	TRC	New track line along the SGR
3	Tegeta line	21.7km	Aga Khan-Tegeta	Middle	2,662	TRC	New line with elevated structure
4	Extension line between Mwenge and Ubungo	4.5km	Mwenge-Ubungo	Middle	333	TRC	Connecting to existing line with elevated structure
5	Morogoro line	26km	Kibaha-Ubungo	Middle	2,705	TRC	New line with elevated structure
6	Extension line between Aga Khan and Central	4.7km	Aga Khan-CBD	Long	2,224	TRC	Connecting to existing line with underground structure
7	Extension line between Tegeta and Bunju	13km	Tegeta-Bunju	Long	1,148	TRC	Extension of Tegeta line with elevated structure
8	Kilwa line	15km	CBD-Vikindu	After 2040	1,685	TRC	New line with elevated structure
9	Capacity Development	-	-	Before commencement		TRC	Capacity development of TRC or new organization shall be developed before the commencement of commuter railway.
Total		**116.6 km**			**11,732**		

Source: JST



Source: JST

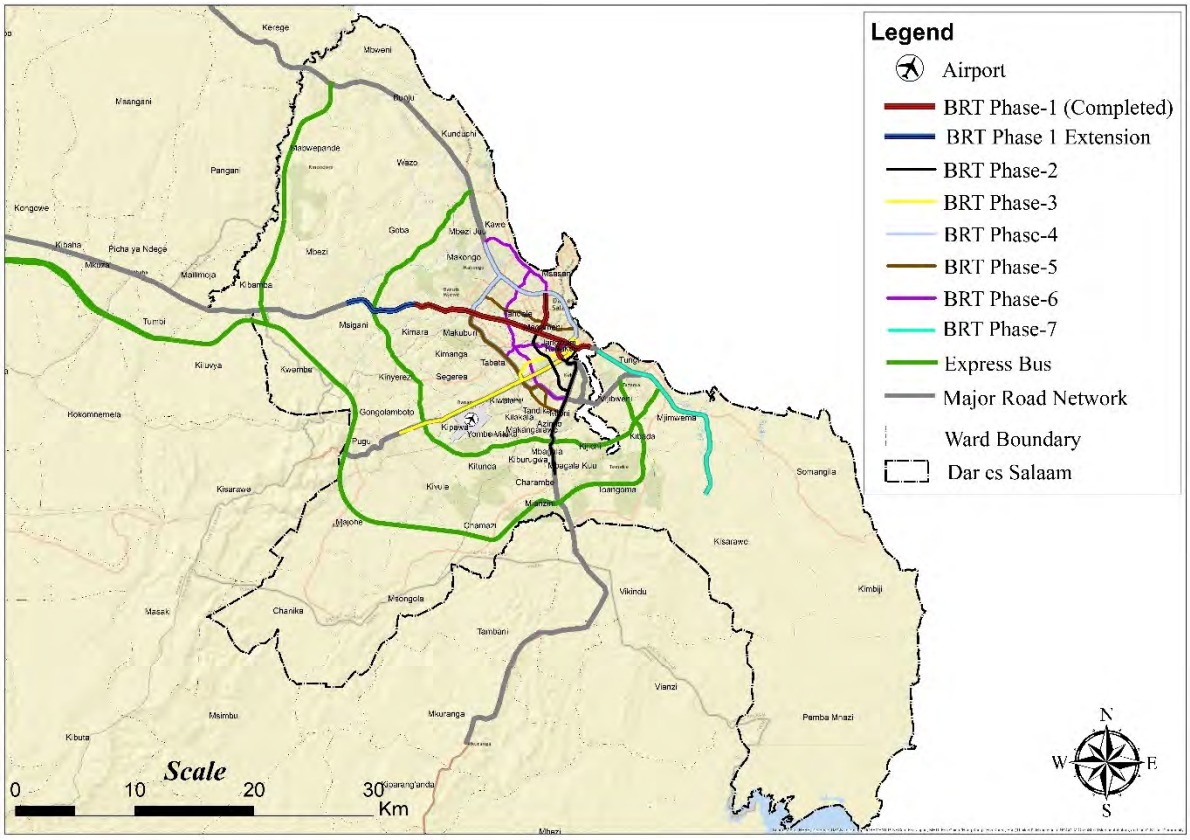
Figure 10.3.28 Railway (MRT) Proposed Project

(2) BRT Project

Table10.3.24 BRT Proposed Project List

No	Name of Project	Length Area	Section Place	Term	Construction Cost (Billion TZS)	Implementation Body	Notes
1	BRT Phase-1 Eextension	6.5km	Morogoro Road	Short	53	DART	
2	BRT Phase-2	20.1km	Kilwa Road	Short	158	DART	On-going AfDB fund
3	BRT Phase-3	22.6 km	Nyerere Road	Short	174	DART	On-going WB fund
4	BRT Phase-4	20.8km	Bagamoyo Road, Sam Nujoma Road	Short	171	DART	On-going WB fund
5	BRT Phase-5	24.3km	Nelson Mandela Road etc.	Medium	178	DART	
6	BRT Phase-6	30.2km	Old Bagamoyo Road	Medium	223	DART	
7	BRT Phase-7	17.7km	Kigamboni Area	Long	154	DART	
Total		**142.2km**			**1,111**		

Source: JST



Source: JST

Figure 10.3.29 BRT Proposed Project

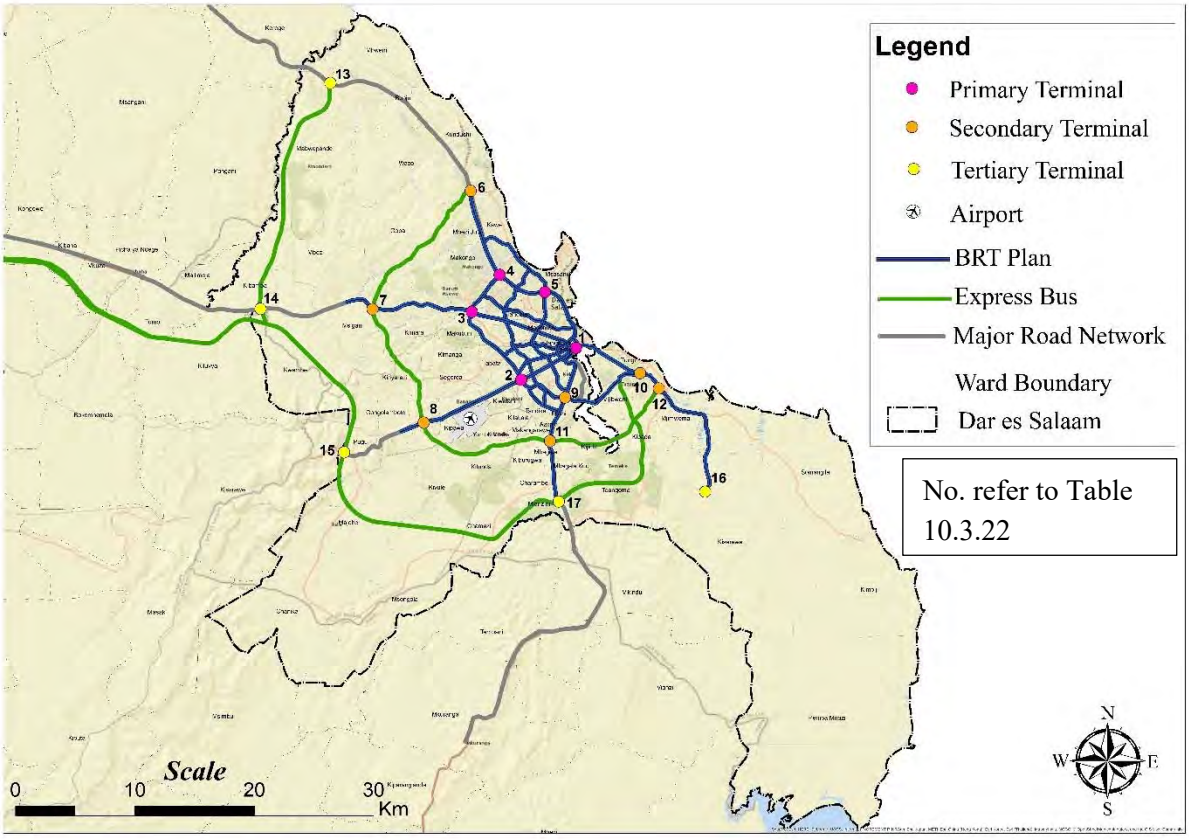
(3) Terminal and Feeder Bus Project

Table 10.3.25 Terminal and Feeder Bus Project List

No	Name of Project	Length Area	Section Place	Term	Construction Cost (Billion TZS)	Implementation Body	Notes
Primary Terminal							
1	Primary T-1	10,000m²	CDB	Short	2.5	TBD	
2	Primary T-2	10,000m²	Tazara	Medium	2.5	TBD	
3	Primary T-3	10,000m²	Ubungo	Short	2.5	TBD	
4	Primary T-4	10,000m²	Mwenge	Medium	2.5	TBD	
5	Primary T-5	10,000m²	Morocco	Long	2.5	TBD	
Total		**50,000m²**			**12.5**		
Secondary Terminal							
6	Secondary T-1	20,000m²	Tegeta	Medium	5.1	TBD	
7	Secondary T-2	20,000m²	Mbezi	Short	5.1	TBD	
8	Secondary T-3	20,000m²	Ukonga	Medium	5.1	TBD	
9	Secondary T-4	20,000m²	Temeke	Medium	5.1	TBD	
10	Secondary T-5	20,000m²	Kigamboni 1	Long	5.1	TBD	
11	Secondary T-6	20,000m²	Mbagla	Medium	5.1	TBD	
12	Secondary T-7	20,000m²	Kigamboni 2	Long	5.1	TBD	
Total		**140,000m²**			**35.7**		
Tertiary Terminal							
13	Tertiary T-1	20,000m²	Bunju	Long	5.1	TBD	

14	Tertiary T-2	20,000m²	Luguruni	Long	5.1	TBD	
15	Tertiary T-3	20,000m²	Pugu	Long	5.1	TBD	
16	Tertiary T-4	20,000m²	Kigamboni	Long	5.1	TBD	
17	Tertiary T-5	20,000m²	Mazinga	Long	5.1	TBD	
Total		**100,000m²**			**25.5**		
Ground Total		**290,000m²**			**73.7**		
Feeder Bus (see Figure 10.3.24 "image of feeder bus route system")							
18	Bagamoyo line area	-	Bagamoyo Road's Suburban Area	Short- Long	-	Private Bus Operator	Feeder bus operation of each route will be developed with the pavement of collector roads and MRT or BRT route development
19	Morogoro Line Area	-	Morogoro Road Road's Suburban Area		-		
20	Nyerere Line Area	-	Nyerere Road's Suburban Area		-		
21	Kilwa Line Area	-	Kilwa Road's Suburban Area		-		
22	Kigamboni Line Area	-	Kigamboni Road's Suburban Area		-		

Source: JST



Source: JST

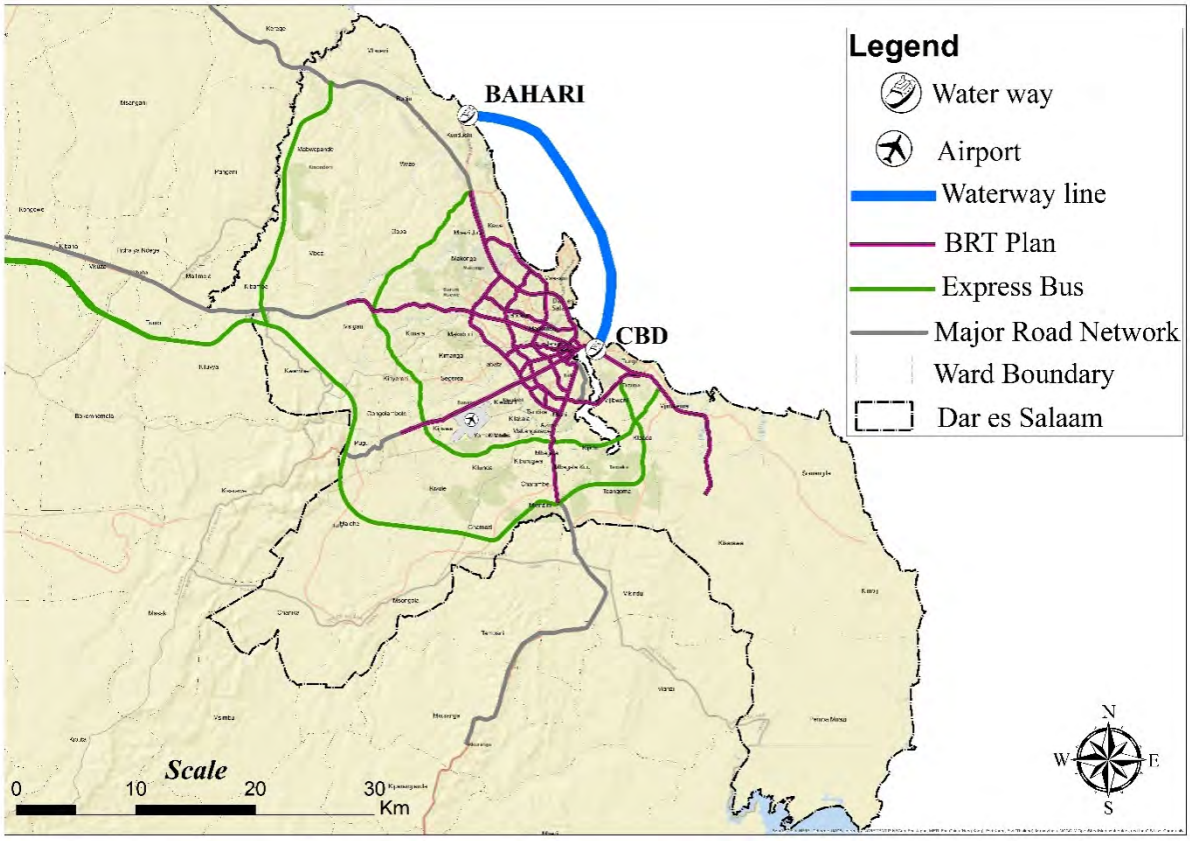
Figure 10.3.30 Terminal Proposed Project

(4) Waterway Transport Project

Table 10.3.26 Waterway Transport Proposed Project List

No	Name of Project	Length Area	Section Place	Term	Construction Cost (Billion TZS)	Implementation Body	Notes
1	Waterway Transport	Appx. 20km	CBD-Bahari	Short	52	TBD	-Two ferry boats purchase -Two piers construction cast and land acquisition cost

Source: JST



Source: JST

Figure 10.3.31 Waterway Transport Proposed Project

10.4 Logistic Plan

10.4.1 Logistic Transport Strategy

(1) Current issues regarding Logistic Transport

- Rapid increase of transit cargo volume

Traffic at Dar port is projected to increase from a throughput of 13.5m tons in 2013 to 28m tons in 2028, with container throughput increasing from 581,000 Twenty-Foot Equivalent Units (TEUs) handled in 2013 up to 1,138,000 TEUs in 2018 and 3,226,000 TEUs in 2028. Based on these figures, annual growth rate of cargo can be seen as 4.9% in tons and 12% in TEUs between 2013 and 2028.

Table 10.4.1 Actual and Forecasted Cargo Throughput

	2007	2008	2009	2010	2011	2012		2012	2013	2014	2015	2018	2023	2028
	Actual Data							Forecasts						
Dry Bulk ('000 tons)	1,160	966	1,231	1,197	1,231	1,595	H.F.	1,682	1,849	2,037	2,246	3,032	4,662	6,930
							L.F.	1,471	1,584	1,706	1,839	2,306	3,031	3,997
Break Bulk ('000 tons	518	411	573	695	524	--	H.F.	443	455	469	485	537	656	822
							L.F.	339	349	359	370	398	463	552
Vehicles ('000 Units)	41	49	52	68	51	--	H.F.	509	581	674	768	1,138	1,922	3,226
							L.F.	67	73	80	87	112	165	242
TICTS ('000 TEU)	312	336	308	330	355	--		--	--	--	--	--	--	--
TPA ('000 TEU)	24	38	17	83	122			--	--	--	--	--	--	--
Total Container ('000 TEU)	336	372	325	423	477	--	H.F.	509	581	674	768	1,138	1,922	3,226
							L.F.	446	486	534	589	729	1,060	1,522

H.F.: High forecasts, L.F: Low forecasts

Source: Port of Dar es Salaam Modernising of Berths 1 – 7 Final Report, TPA

- Construction of Kisarawe ICD

A new inland container/clearance depot (ICD) is to be constructed at Kisarawe to supplement the limited storage capacity for containers inside the port. The new ICD will be linked with the existing lines of Tanzania Railway Limited (TRL) and the Tanzania Zambia Railway (TAZARA).

- Bagamoyo Port Project

To cope with growing cargo traffic as manifested by the growth of containerised cargo at Dar es Salaam Port, development of a new port at Bagamoyo (about 75km north of Dar es Salaam) has been proposed under a public private partnership scheme.

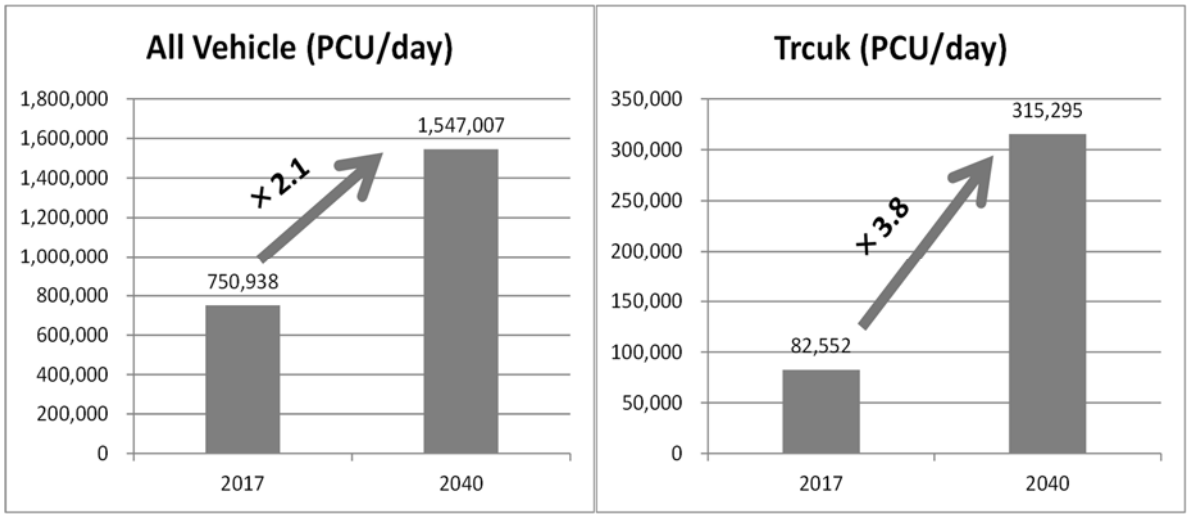
- Problem on Mobility as Travel Speed and Travel Time

Travel speed and time along arterial roads within Dar es Salaam were worsened from year 2007 to year 2017. It means that transportation condition was also worsened.

(2) Logistic Transport Network and Demand

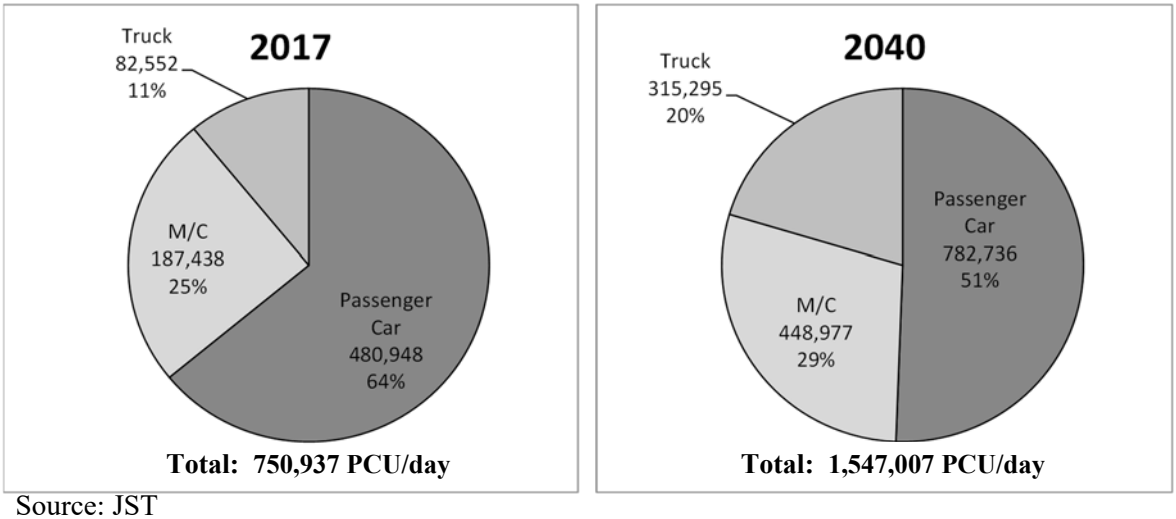
Logistics transport demand forecast was analysed based on the results of OD survey and interview survey to cargo transport companies.

Current and future number of vehicle trips is shown in Figure 10.4.1. Truck volume is 3.8 times the annual growth rate of 6% between 2017 and 2040 which is higher than the ratio of all vehicle trips. The share of trucks will increase from 11% in 2017 to 20% in 2040.



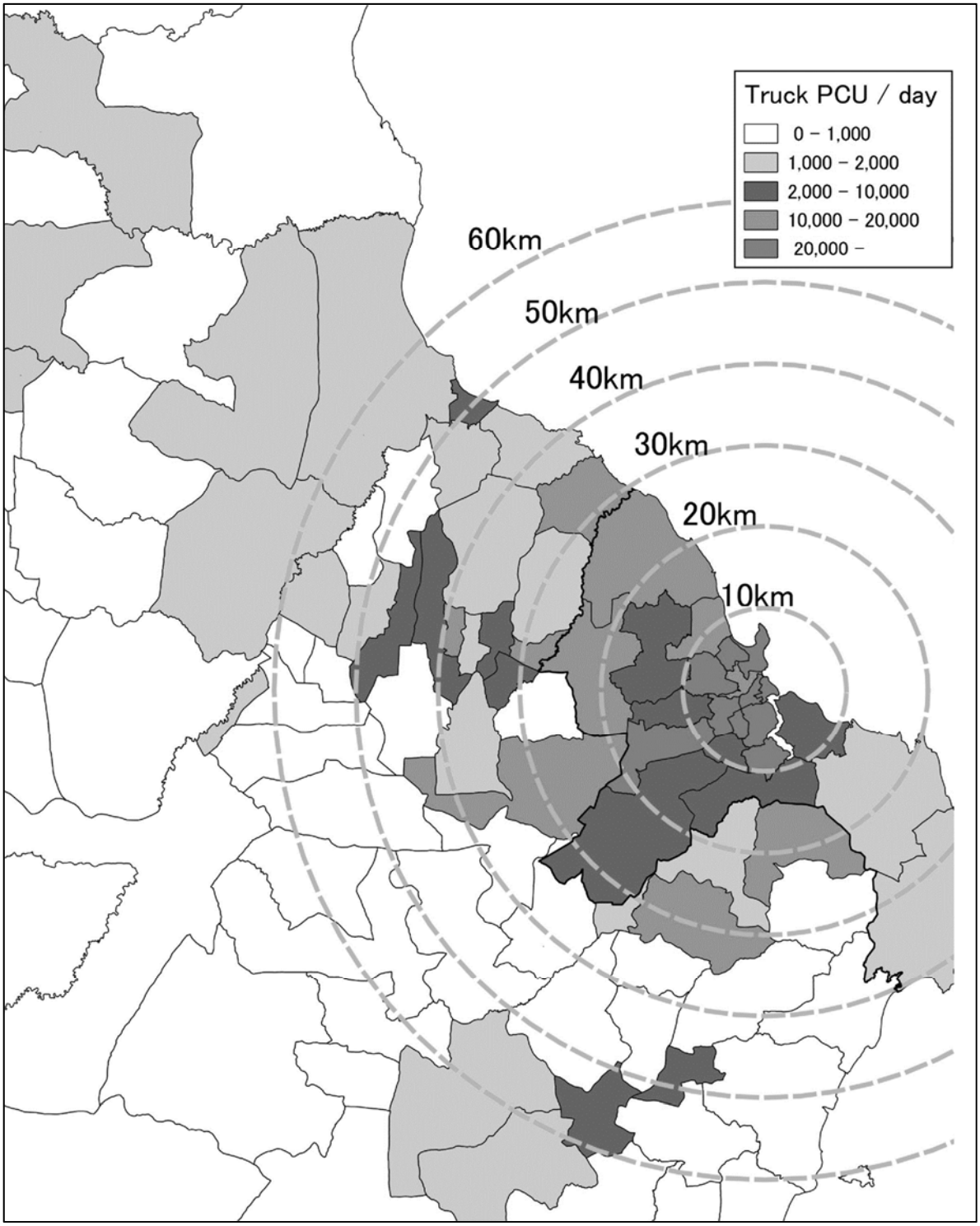
Source: JST

Figure 10.4.1 Number of Vehicle (PCU) by All Vehicle and Truck in Current and Future



Source: JST

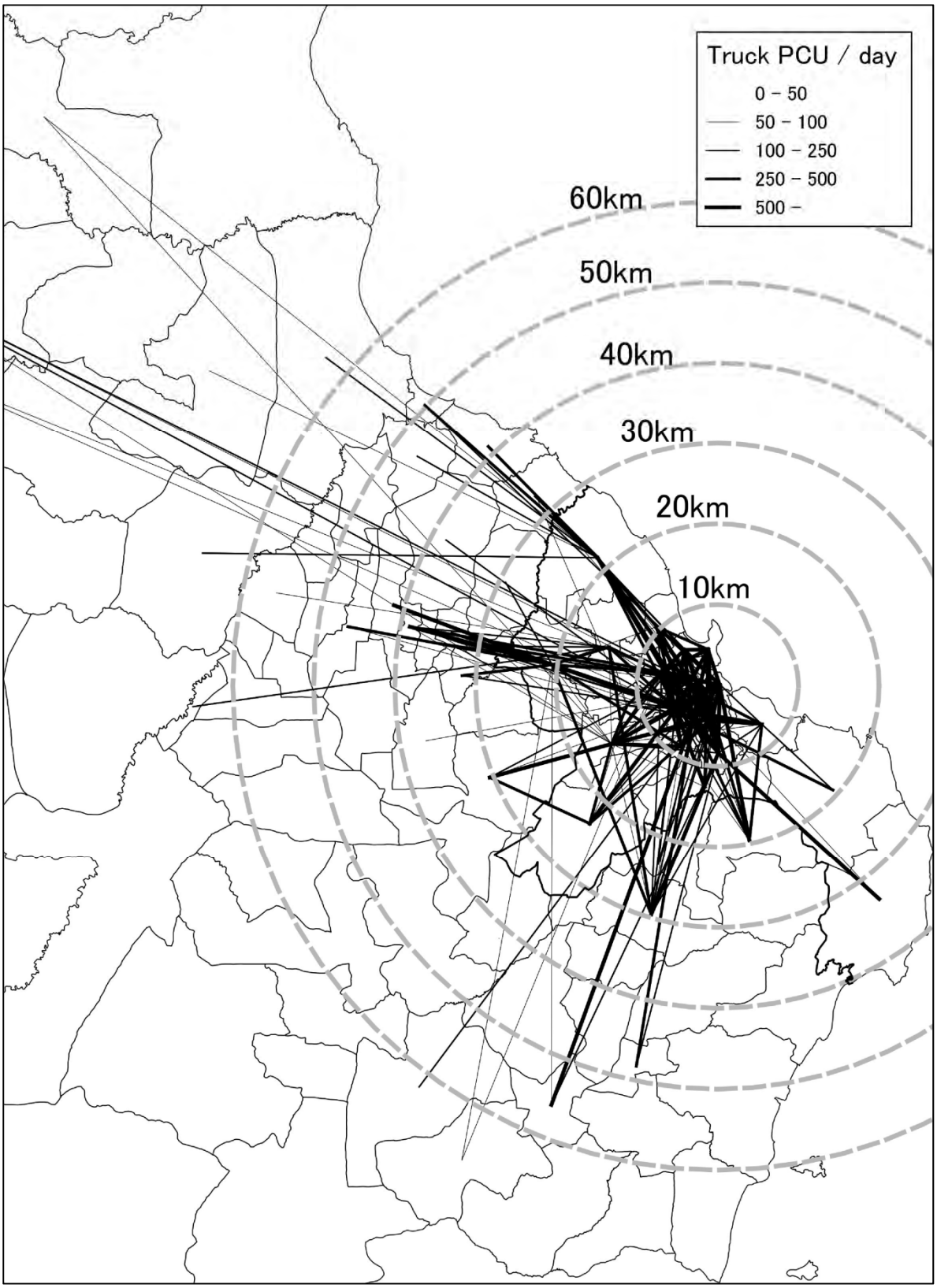
Figure 10.4.2 Vehicle Share in 2017 and 2040



Source: JST

Figure 10.4.3 Number of Truck (PCU) Generated by each Zone in 2040

Figure 10.4.4 shows desire line of truck movement in 2040. The long-distance trips will increase beyond the city boundary especially for Bagamoyo and Morogoro direction.



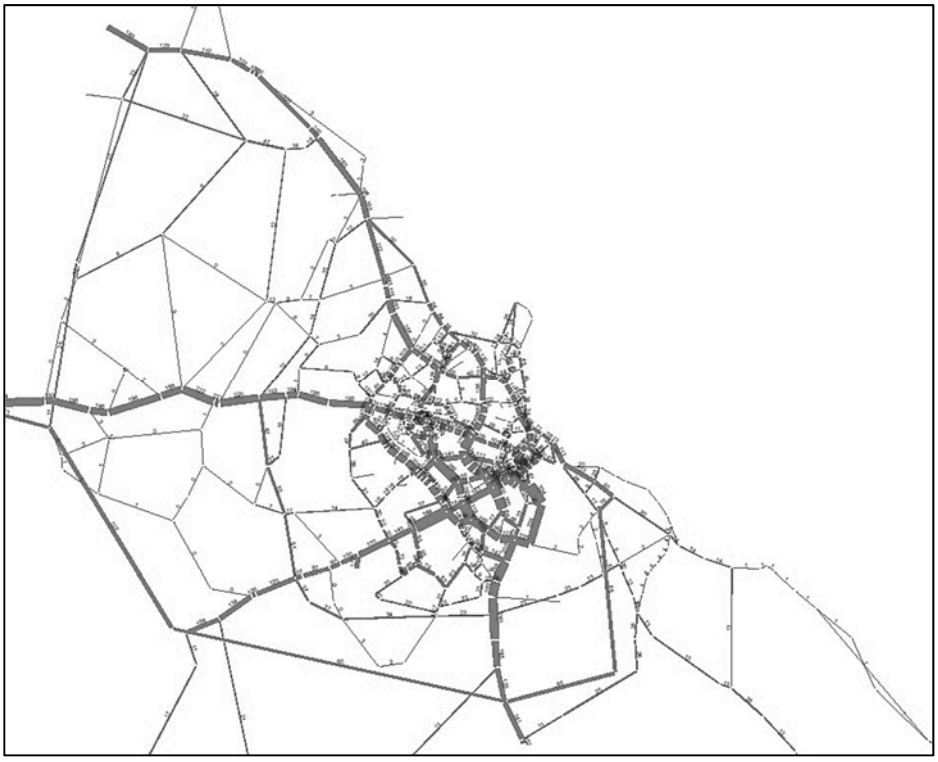
Source: JST

Figure 10.4.4 Desire Line of Truck Movement in Future

Logistics transport movement in future cases such as in do-nothing case and master plan case are shown in Figure 10.4.5 and Figure 10.4.6 respectively. Master plan case can be seen to be more successful in distributing truck demand more than the do-nothing case wherein too many trucks concentrate on Kawawa Road and Nelson Mandela Road.

Source: JST

Figure 10.4.5 Future Logistics Movement (Do Nothing Case)



Source: JST

Figure 10.4.6 Future Logistics Movement (Master Plan Case)

(3) Logistic Transport Strategy

To solve the current issues on logistics transport, following two strategies are put forward:

i) Strategy 1: To strengthen the connection between international corridor and domestic road networks; and

ii) Strategy 2: To alleviate bottlenecks in Dar es Salaam.

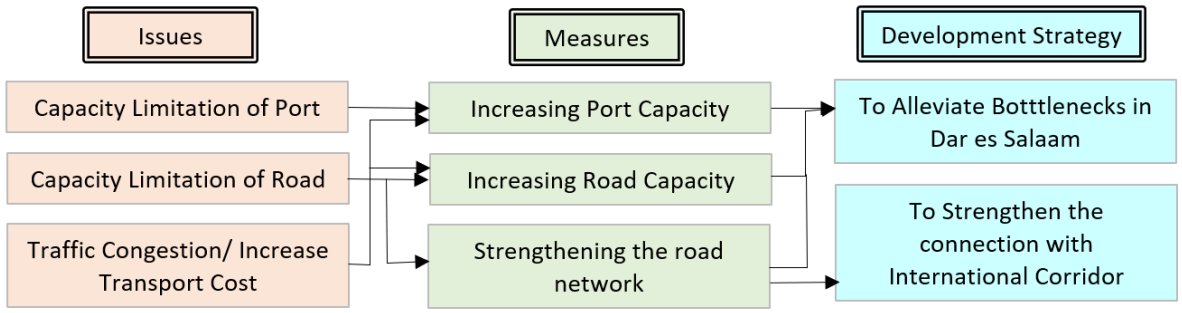


Figure 10.4.7 Development Strategies of Logistic Transport Plan

a) To strengthen the connection between international corridor and Dar es Salaam urban road networks

By connecting international corridor and urban roads in Dar es Salaam by urban expressway and ring roads, transportation time and cost will be reduced and economic condition in Tanzania will be increasingly revitalised.

b) To alleviate bottlenecks in Dar es Salaam

Considering the rapidly expanding economy in Tanzania and the neighbouring landlocked countries, the current capacity of the urban infrastructure in Dar es Salaam, including the port and urban road network, will exceed its capacity in the near future. In the port sector, the planned expansion of the existing Dar es Salaam Port will not be sufficient to meet the demand forecast. Construction of an alternative port or ports must be considered. Selection of a suitable site for an alternative port and detailed planning of the port including infrastructure and supporting facilities are urgent matters.

Regarding the road sector, congestion within and around the Dar es Salaam area is already becoming a bottleneck for freight transport from Dar es Salaam. To address this issue, alleviation of traffic congestion through measures such as the widening of the existing roads and developing outer ring roads and bypasses are required.

10.4.2 Logistic Transport Plan

(1) Road Development

To reduce the logistics transportation time and to improve logistical efficiency, the following road development and improvement plans are required:

- Construction of Outer Ring Road, Middle Ring Road with missing link
- Construction of Urban Expressway
- Grade-separation of Major Intersection (Ubungo, Mwenge, etc.)

The above-mentioned details are referred to in 10.2 Road Plan.

(2) Sea Port Development

a) Development and Improvement of Container Terminal Berths at Dar es Salaam Port

Construction of new container Berths No.13 and No.14 and expansion of the berths No. 1 to No.7 and port terminal at Dar es Salaam Port have been commenced to improve the operational and spatial efficiency and to increase handling capacity.

b) Kisarawe ICD

Construction project of inland container depot at Kisarawe is important for the support of Dar es Salaam Port with its expanded capacity for 1.2 million TEUs.

c) New Port at Bagamoyo

A new major port and its affiliate industrial zone at Bagamoyo are necessary to accommodate rapidly growing container traffic, which cannot be handled by Dar es Salaam Port alone. The Bagamoyo Port is meant to address congestion at the old port and support Tanzania to become East Africa's leading shipping and logistics centre.

10.5 Traffic Management

10.5.1 Traffic Demand Management Strategy

(1) Traffic Issues Regarding Traffic Management

a) Causes of Traffic Congestion

As mentioned in past chapters, there are several causes of traffic congestion. On the traffic management field, JST specified causes of congestion in DSM City.

i. <u>Traffic Concentration</u>

Traffic concentrates on major radial and ring road in DSM City. However, there are a few detour-routes for avoiding congestion. Therefore, serious congestion occurs on intersections across radial and ring roads such as the Tazara intersection. Future traffic demand is expected to increase to double of the present demand. It is necessary to control the traffic movement in DSM.

ii. <u>Poor Infrastructure</u>

There are some road sections which have poor drainage facilities. Once flooding happens, the road cannot function. In addition to this, there is no information provision about the disaster. Road users cannot know the situation even if some roads were closed due to the disaster. A lack of road infrastructure and alternative solutions for avoiding disaster are some of the issues.

iii. <u>Parking Problem</u>

Parked vehicles block smooth traffic flow because illegal on-road parking decreases road capacity.

Parked vehicles also block sidewalks used by pedestrians. This situation might increase traffic accidents. Parking space in CBD area is limited, but much traffic enters the CBD area by car. In order to decrease vehicles entering the CBD, modal shift from private vehicles to public transport is important. However, mode transfer terminals and stations are insufficient.

iv. Lack of Traffic Signal

There are few signal intersections in DSM City. Traffic signals are not adjusted based on the real-time traffic situation. Traffic police controls vehicle movement manually at some congested intersections; hence, traffic movement has not been harmonised in the city. Therefore, traffic control based on the real-time situation is needed.

v. Lack of Public Transport Service

Operation area of public transportation is limited. In addition, connection between private vehicle and public transport or between both public transports is poor, and convenience of public transport is low.

vi. Traffic Accident

Traffic accidents occur along major roads, especially along the BRT route. It is assumed that cause of traffic accidents is changed or increased by introducing BRT. BRT route will be introduced to other roads. It is necessary to consider the solution for traffic accidents based on the future change of traffic situation by introducing new BRT routes.

vii. Many stakeholders related to Traffic Management

There are many stakeholders related to traffic management: TANROADS, SUMATRA, DCC, Police, and MOWTC. To conduct appropriate traffic management, a demarcation of each organization should be clarified.

Table 10.5.1 Demarcation of Traffic Management-Related Organizations

	TANROADS	SUMATRA	DCC	POLICE	MOWTC
Traffic signal	Installation (by TEMESA) (Trunk road)	-	Advise	Control (congestion)	-
Parking	-	-	Regulate	-	-
Traffic safety	Install facilities		Planning	Enforcement/ Education	Accident (Analysis)
Traffic Regulation	-	Plan/ Regulate	-	Enforcement	-
Heavy Vehicle Management	Regulate	Plan/ Regulate	-	-	-

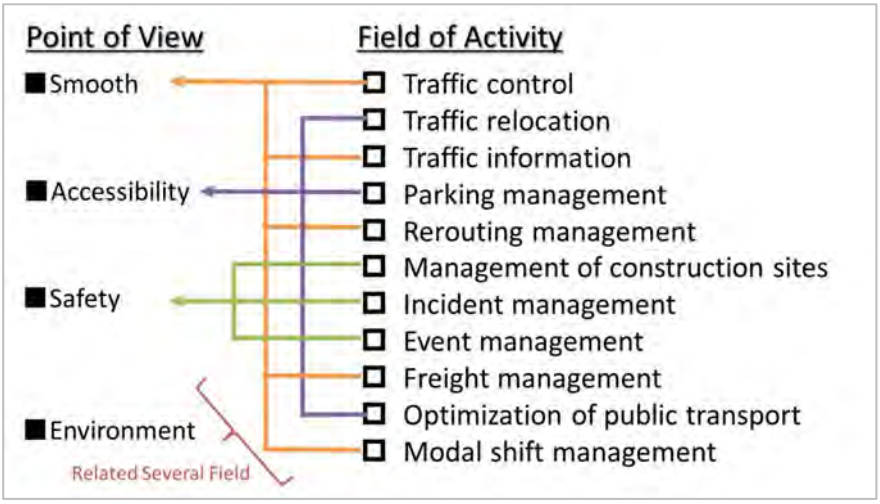
Source: JST

(2) Key Point of Traffic Management in DSM City

Traffic flow is greatly affected by social demands for traffic and geographic conditions of roads. Traffic management is related to each urban and transportation field such as land use, road network, public transport service, traffic safety and regulation, etc. If there is some change in urban and urban

transport situation, traffic behaviour is also changed. Therefore, traffic management field has to consider several conditions and situations affecting traffic movement.

Field of activity of traffic management consists of the following measures, and JST categorized these measures to four points of view: Smooth, Accessibility, Safety, and Environment. The countermeasure to realise these points of views is the goal for traffic management in DSM.

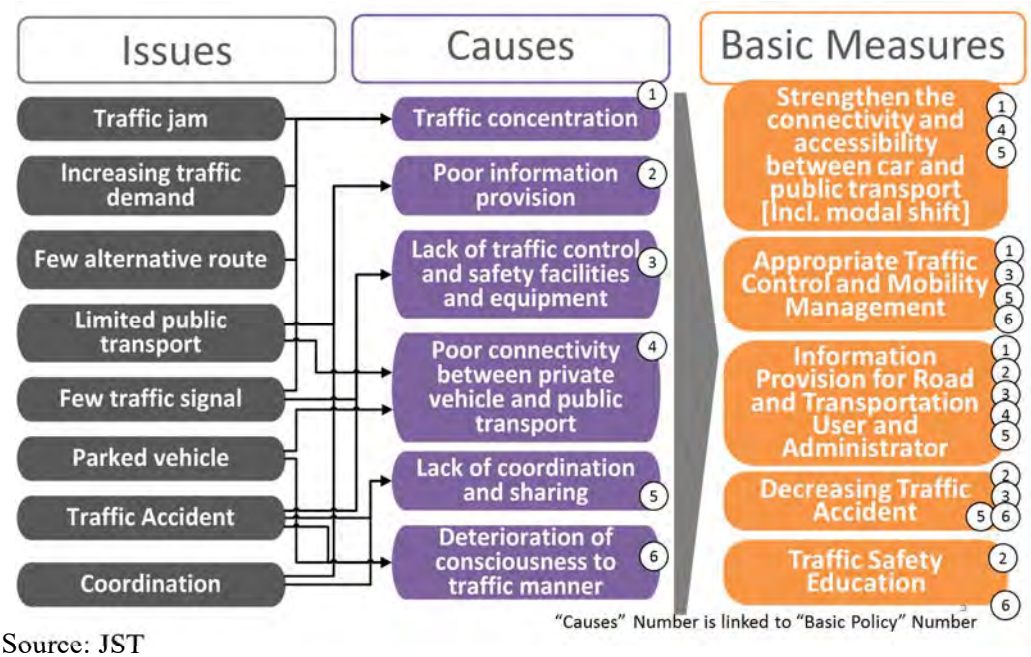


Source: JST

Figure 10.5.1 Point of View and Field of Activities for Traffic Management

(3) Policy for Traffic Management

Based on the above, JST set the basic policy, "To realise optimal traffic control for traffic circulation in DSM City". To achieve this policy, traffic demand management and intelligent transport systems (ITS) should be utilized mutually for effective traffic management in future DSM City. Figure 10.5.3 shows the relationship among issues, causes, and solutions. According to this, JST proposed three component projects, (1) Mobility Management Project, (2) Improvement of Traffic Circulation Project, (3) Traffic Safety Project.



Source: JST

Figure 10.5.2 Issues, Causes, and Solution for Traffic Management

(4) Strategy of Traffic Management

Traffic management is one of the useful solutions for traffic congestion. The advantage of traffic management is that the project cost is not high compared to big construction projects like construction of bypass road, expressway, etc.; also, the project period is not so long. However, the effect of traffic management is only limited. There are few fundamental effects, and some measures need some time to change people's traffic behaviour. Therefore, traffic management should be coordinated and harmonised with road and public transport project for ensuring the appropriate effect. Furthermore, traffic management project has been conducted as pilot project of CUPID project, and it should be utilised for this master plan.

As the basic implementation strategy, traffic management project will be conducted by middle term (2030) before implementation of road and public transport project which is included ring road project and circular rail. After implementation of road and public transport project, implementation area of traffic management project will be expanded and adjusted. In this master plan, JST proposes two traffic management areas; (1) Strategic Traffic Management Area, which is within Nelson Mandela Road, (2) Traffic Management Area, which is within Middle Ring Road and along main trunk roads as shown in Figure 10.5.8. Some traffic management projects were proposed in consideration of the above two areas.

Traffic optimisation and ITS project are main projects to be commenced in short term. Traffic optimisation provides smooth traffic utilising existing road facilities. ITS provides real-time traffic information to road and public transport users for selecting best routes and modes.

10.5.2 Traffic Congestion Reduction Plan including ITS

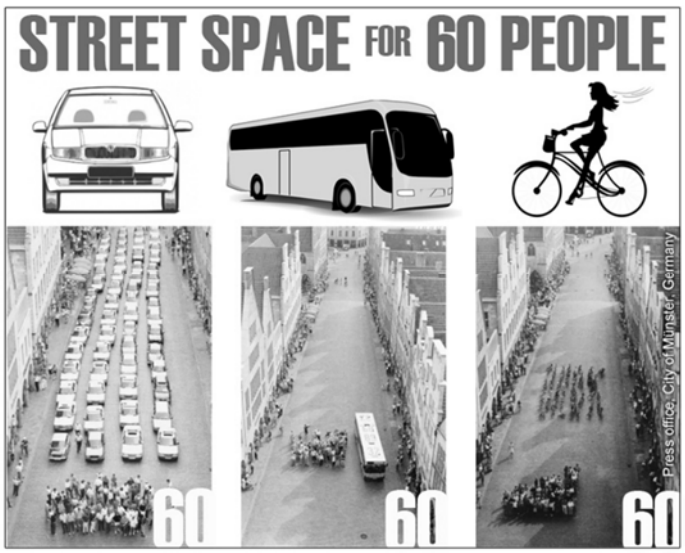
The traffic congestion reduction plan is composed of seven projects which are categorized into two components: Mobility Management and Improvement of Traffic Circulation. The project details are shown below.

(1) Component 1: Mobility Management

a) Promoting Modal Shift

i. Concept of the project

As shown in the result of traffic demand forecast, it is expected that traffic situation in DSM will be more serious without any road and public transport projects. However, road network in DSM is close to over-capacity, because the urban area of DSM has already densified and expropriation of land for new road construction has been difficult and costly. Therefore, "Modal Shift" is needed for ensuring smooth traffic flow and economic activities in the future. Road traffic and transportation administrator should promote "Modal Shift" measures to road traffic users. Promoting modal shift is also related to decreasing CO^2 emission and providing all people the opportunity of move. This project should be taken by all road traffic related organisations, mainly MOWTC, DCC and municipalities.



Advantage:
- Decrease CO^2
- Mitigate congestion
- Decrease traffic accidents
- Punctuality

Etc.

Disadvantage:
- Need to pay transportation fare
- Waiting time for arriving bus/train
- Not door-to-door

Etc.

Source: City of Münster (Left side figure), JST

Figure 10.5.3 Effect of Modal Shift and Advantage/Disadvantage of Modal Shift

ii. Action Plan

The target areas are DSM City and its neighbouring cities. After implementation of BRT (Phase-II～VI) and MRT, promotion activity should be enhanced. Each implementation schedule including this project is shown in the Figure 10.5.4.

Action 1: Encouraging of modal shift to public transport
(by Publication, Seminar, Mass Media, Education, Incentive)

Action 2: Improvement/Construction of access road to the BRT/MRT stations, and improving facilities of vehicles and BRT/MRT stations (Priority seat, Guide sign, Time table, Route Map, etc.)

Action 3: Increasing frequency of No. of operation of BRT/Railway

b) Parking Management

i. Concept of Project

Illegal parking on the road is one issue of traffic congestion in DSM. There are some parking lots or parking space along the building as described in chapter 5.1.5, however there is a lot of illegal parking of vehicles in CBD area because existing parking space is already full due to the traffic concentration to city centre. This implies that parking space itself might induce traffic to that area. Therefore, when parking management would be conducted, it is important to consider "selection and concentration" for adjusting traffic inflow to the urban area. Location and type of parking space in the CBD or sub-centre should be selected appropriately to avoid traffic concentration. In addition to this, DCC has experience in parking management by pilot project of CUPID, Samora Avenue Renovation project. This experience and knowledge should be utilised for this project.

Source: JST

Figure 10.5.4 Example of CUPID Pilot Project (Parking and Footpath Renovation on Samora Ave.)

When the MRT and additional BRT are introduced, parking space will be needed near their station or terminal for transhipment and P&R (Park & Ride). It is desirable that parking space with 100–200 vehicles parking would be provided for user convenience, and it also has effects such as promoting modal shift and P&R. The transfer location at main MRT/BRT terminal should be provided with enough parking spaces. There are two types for P&R; one is in Strategic Traffic management area along loop line and another is in Traffic management area near satellite cities more than 15km away from CBD. The former would be provided for business trips by 2030, the latter would be provided for long-distance commuters by 2040.

Control of parking fee is also one of the management measures for parking vehicle demand. Traffic concentration to CBD area is one of the major issues, and it is effective to change parking fees for decreasing traffic concentration into CBD area. However, it is necessary to strengthen crackdown and punishment of illegal parking in parallel with parking fee management. This project should be taken mainly by DCC and municipalities.

ii. Action Plan

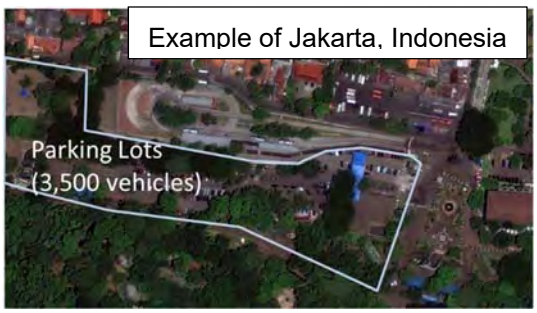
The action plan of this project is as follows. Outline map is shown in Figure 10.5.6.

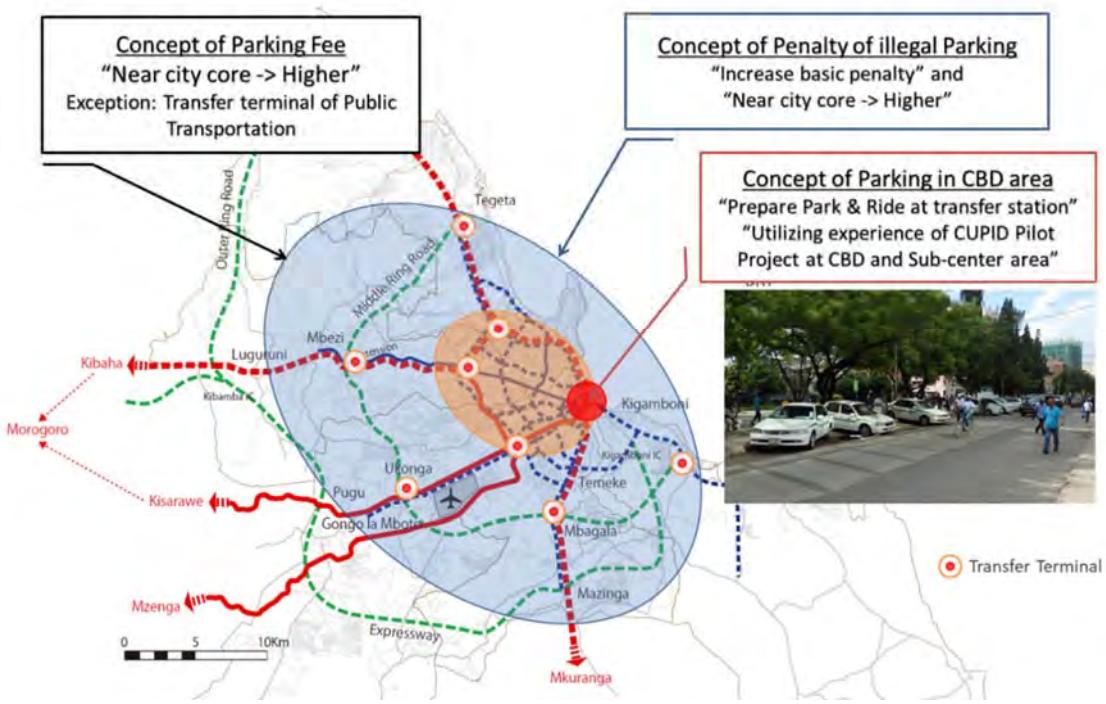
Action 1: Constraining inflow vehicle to the city centre

- Increasing Parking Fee in CBD area
- High penalty against Illegal parking

Action 2: Construction of parking area for Park & Ride

Action 3: Utilizing existing road space for parking (Tentative street-parking, Demand Control by time (early morning, midnight, etc.))





Source: JST

Figure 10.5.5 Concept Map of Parking Management

c) Measure for Improving Mobility

i. Concept of Project

This project is composed of lane and time management. The former is to prepare the exclusive lane or priority lane by separating lane distribution for pedestrians and bicycles. The latter is to give motivation to change people's minds about the daily traffic movement by incentive measures such as staggered commuting and commuter pass.

This measure should be conducted with other construction projects such as road improvement or introduction of public transport for effective implementation[1], and it is important to readjust the plan based on actual traffic demand and situation. This project should be taken mainly by MOWTC, DCC and municipalities.

ii. Action Plan

The action plan of this project is as follows.

Action 1: Specifying priority lane, corridor, and area

(To avoid conflict between pedestrian, bicycle, and vehicle, to promote priority of pedestrian)

[1] Bicycle lane along Morogoro road was installed in parallel with implementation of BRT phase-I.

Action 2: Promotion for incentive measures

(Car free day (Promotion event for pedestrian priority), Incentive for Staggered Commuting, Commuter Pass for BRT/MRT)

Example of Jakarta, Indonesia

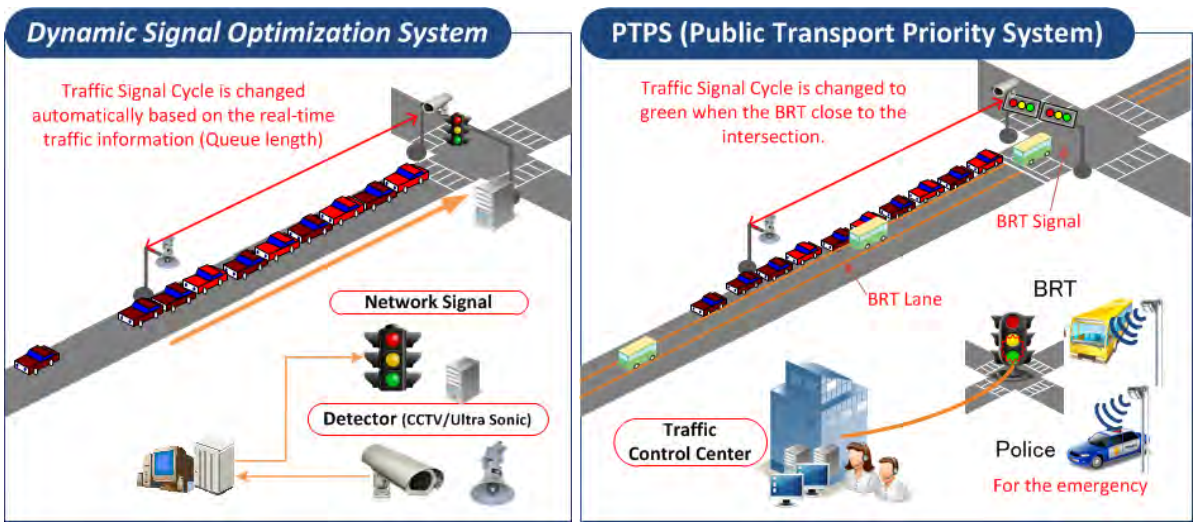
(2) Component 2: Improvement of Traffic Circulation

a) Traffic Signal Optimization

i. Concept of Project

As described in chapter 5.1.5, existing traffic signals are used by fixed cycle, and it is not used appropriately for serious traffic congestion. Traffic police has controlled traffic manually, but it is difficult to mitigate traffic congestion by their activity only. DSM city is growing, and traffic situation is changing by urbanising. Traffic signal cycle should be matched with actual traffic situation for effective traffic control, and it is needed to install advanced traffic signals which can harmonise with neighbouring or surrounding traffic signal cycle for traffic management in future DSM.

This project includes installation of advanced traffic signals and construction of traffic control centre in DSM. Traffic control centre can control traffic signals based on the real-time traffic volume and provide traffic related information to road users. This system should include bus priority signal system for BRT, and it is necessary to install traffic signals with adapted signal control system. For changing traffic signal cycle and phase in real-time, traffic detectors are also installed along with major roads and intersections. CCTV cameras are also installed for monitoring traffic situation and road condition by road administrator. This project should be taken by some road administrators, mainly MOWTC, DCC, TANROADS, and traffic police.



Source: JST

Figure 10.5.6 Dynamic Signal Optimization and Public Transport Priority System

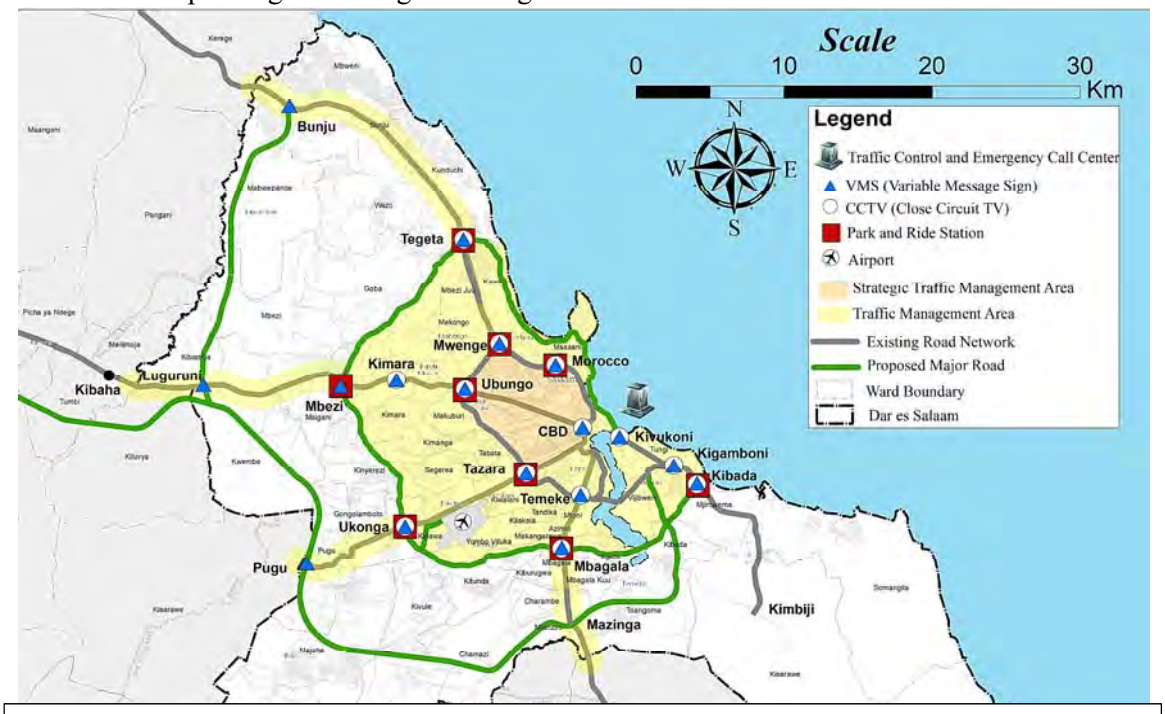
World Bank is now studying for scoping traffic control centre and ITS, and was at its preliminary stage as of November 2017. Their idea is almost same as this proposed project, but their target area of traffic management is along BRT corridor. JST proposed that target area should be city-level for area traffic control and optimisation.

The other important thing is to decide on the main player of traffic management. The main player should manage and control traffic signal system and traffic control centre because the main player has the right of collecting/monitoring/processing/controlling all traffic-related data from other organisations and roadside equipment. Therefore, the main player needs strong power in order to lead other traffic-related organisation, and they should manage and operate them properly with basic traffic data and information. JST suggested recommendation of demarcation of traffic management in chapter 10.5.5.

ii. Action Plan

The action plan of this project is as follows. Implementation area would be expanded step by step based on the future road project and growth of the city. As mentioned above, JST proposes two traffic management areas; (1) Strategic Traffic Management Area and (2) Traffic Management Area. Both areas and concept map are shown in Figure 10.5.8.

Action 1: Clarify responsible organisation for traffic management
Action 2: Construction of Traffic Control Centre
Action 3: Replace old traffic signals for new ones, and install new traffic signals
Note: Traffic information provision should be provided by ITS project in parallel
Action 4: Expanding/increasing traffic signal



Function
- **Dynamic Signal Optimization System & Additional Traffic Signal**
- **Public Transport Priority System**
- **Information Collection & Provision System** (Travel Time, Congestion info, Fleet Control info, Disaster Info)
- **Emergency Info from Emergency Call Centre** (For Police, Ambulance, evacuation for disaster, etc. ~2030)
- **Public announce for traffic rule and safety via VMS**
- **Enforcement**

Source: JST

Figure 10.5.7 Proposed Traffic Management Area by Traffic Optimization and ITS

b) Intersection Improvement

i. Concept of Project

Intersection improvement is effective for smooth traffic at intersections. Its measures are included not only in construction of flyovers but also in road marking, rearrangement of lanes, installation of traffic islands, etc. The confliction of vehicle stream sometimes occurs at intersections, and it becomes a cause of traffic congestion and traffic accidents. It is effective to indicate and control vehicle stream for avoiding such situation. There are 11 intersection improvement projects in DSM as shown in chapter 10.2. Road marking, lane rearrangement, etc., should be considered and implemented in parallel with the construction flyover or intersection improvement. Intersection improvement project should be continued based on the traffic situation at the junction as needed. This project should be taken mainly by TANROADS.

ii. Action Plan

The action plan of this project is as follows.

Action 1: Conduct existing/planned projects

Action 2: Planning improvement measures

Improvement measures for mitigating,,,
(1) Traffic Congestion -> Flyover, Lane rearrangement
(2) Traffic Accident -> Road Marking, Minimize intersection

Note: (Right side Photo) Coloured lane is for right turn vehicle. It provides proper pass and waiting space at intersection.

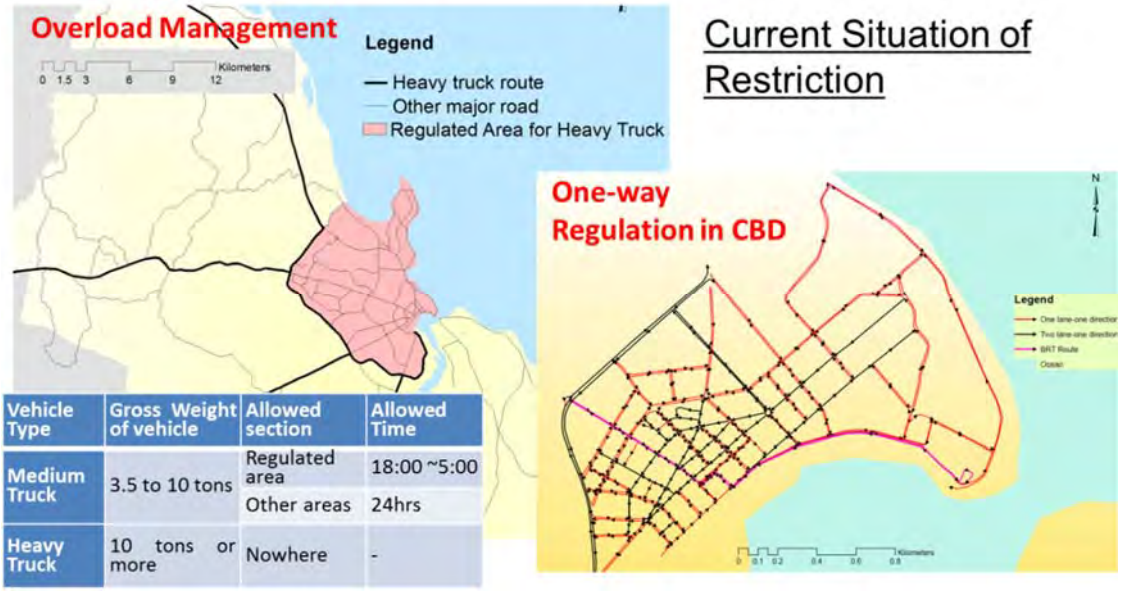
Action 3: Detail Design and Construction Work

c) Area Restriction for Truck and Car

i. Concept of Project

The regulation of area restriction for heavy vehicles has already been implemented in DSM as shown in chapter 5.1.3. This measure should be continued to avoid damage on road surface by heavy vehicles and removing traffic concentration of them to the CBD area. The logistic route is expected to shift to middle ring road after its implementation. When middle ring road would be in-service, restriction area should be expanded by the borderline of middle ring road. However, updated restriction area should be conducted based on the study for avoiding conflict with logistic-concerned personnel or companies. One-way regulation in CBD area should also be continued for smooth traffic in urban areas. This project should be taken by some regulation-related organisations such as

MOWTC, SUMATRA, and police.



Vehicle Type	Gross Weight of vehicle	Allowed section	Allowed Time
Medium Truck	3.5 to 10 tons	Regulated area	18:00 ~5:00
		Other areas	24hrs
Heavy Truck	10 tons or more	Nowhere	-

Source: JST

Figure 10.5.8 Current Regulation of Area Restriction in DSM

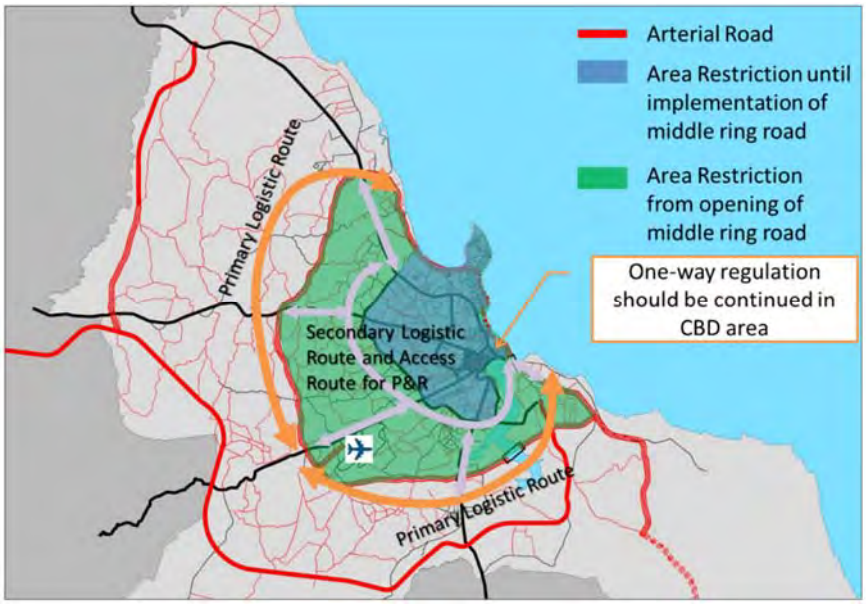
ii. Action Plan

The action plan of this project is as follows, and concept map is shown in Figure 10.5.10.

Action 1: Study for setting restriction area

Until implementation of middle ring road: Existing Area
After implementation of middle ring road: Inside of Middle Ring Road
(Target: Heavy Truck and Trailer (Small should be allowed))

Action 2: Enforcement (Rule, Penalty, Legislation (as needed))



Source: JST

Figure 10.5.9 Area Restriction for Truck and Car

d) Real-time Traffic Information Provision

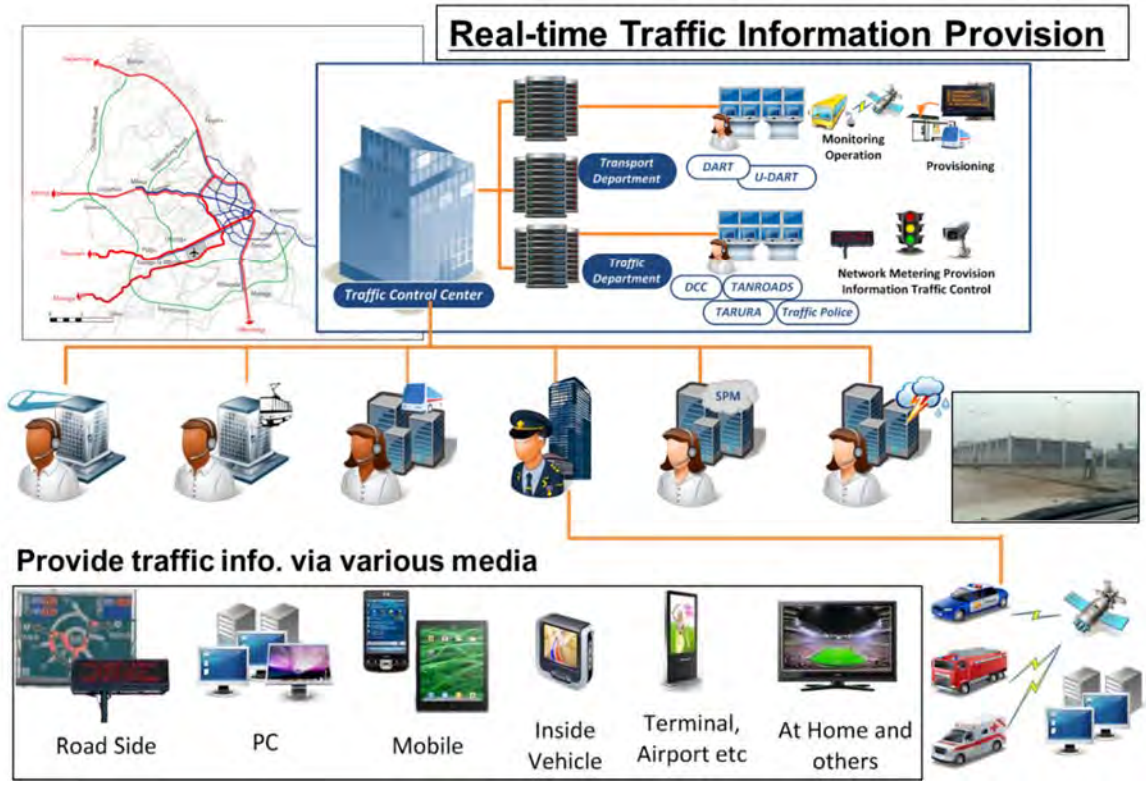
i. Concept of Project

Real-time traffic information provision is one of major project using intelligent transport systems (ITS). ITS assists to have effective utilisation of existing road traffic infrastructure using information and telecommunication technology.

The share of public transport in DSM is high (over 50%), and it is important for public transport users to improve connectivity and accessibility in light of the implementation of BRT phase-II to VI and MRT. ITS can provide useful information such as travel time and congestion route information, etc., to road and public transport users. ITS is also useful for the road transportation administrator, because ITS can collect various information such as traffic accidents, disasters, events, road conditions, road congestion, etc. The function of Collecting Real-time Data System and Monitoring System for road administrator should be installed. This project should be taken mainly by DCC and municipalities. This project should be taken by all road traffic related organizations which have traffic related information and data, mainly MOWTC, DART, TRC, and DCC.

JST proposed that the following information should be provided. This project is not only installation of information provision system but also installation of information provision facilities such as CCTV cameras and Variable message signs (VMS).

- Travel time to Destination,
- Arrival time of Public Transport,
- Congested Route,
- Restriction road by construction work/accident,
- Emergency information such as big accident and disaster,
- Parking information,
- Transfer information for public transport



Source: JST

Figure 10.5.10 Real-time Traffic Information Provision

ii. Action Plan

The action plan of this project is as follows. Target (information collection) area is same as traffic signal optimisation project, but it is assumed that information provision area is not limited in DSM city area only because information provision can be accessed online. Concept map is shown in Figure 10.5.8. Traffic information can be provided by various tools and media such as TV, smartphone, radio, website, etc. The objective of this project is the collection and provision of traffic related information for road users and road traffic administrator. Field equipment should be installed at major intersections, and traffic-related data is collected from this equipment and from traffic-related organisations to traffic control centre. Traffic control centres provide information such as congestion, travel time, closed roads by construction, etc. through the field equipment.

Action 1: Formulation of ITS Master Plan for preparing implementation plan

Note: World Bank has on-going project including considering system architecture

Action 2: Deployment/Installation of ITS Equipment

- CCTV
- VMS (Variable Message Sign)
- Information Board for Road and Public Transportation user

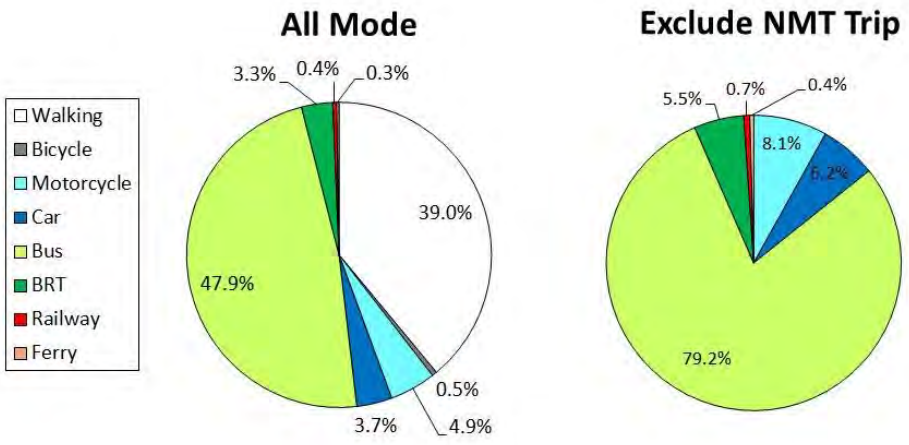
Action 3: Expand/Strengthen system function

- Connected Vehicle
- Use advanced technology
- Other Advanced ITS

10.5.3 Non-Motorized Transport (NMT) Plan

Non-motorized transport (NMT) such as pedestrian and NMT vehicles (bicycle/tricycle, wheelchairs, handcarts, animal drawn carts), is the primary mode of affordable transport for people.

Based on the results of PT Survey by JST, walking is the main mode of travelling in Dar es Salaam as shown in the following figures. On the other hand, the number of bicycles is low (0.5%).



Source: JST

Figure 10.5.11 Mode of Trip based on PT Survey

As well as in other countries, NMT users are often neglected in the development of transport. Vehicle-oriented development is prioritized due to its large social and economic impacts.

These neglected unsafe/inconvenient infrastructures discourage people and further accelerate vehicle-oriented development. It is quite essential for the sustainable development of Dar es Salaam to include NMT in the plan.

Mix of Pedestrian and Vehicle on the road

Sidewalk encroached by shoppers

Source: JST

Photo - NMT Situation in DSM

(1) Improvement Plan for Pedestrian

a) Area to be covered by NMT improvement

Since walkways are widespread over the Study Area, target of countermeasure for pedestrian is specified into the following areas:

- Access route to public transport terminal and public transport station.
- Access route to major facilities.
- Access route to major facilities where large amount of walk trips are generated/attracted, namely market, hospital, etc.
- Area where density of walk trip is high (especially CBD).
- Protection of pedestrians at heavy traffic areas/spots.

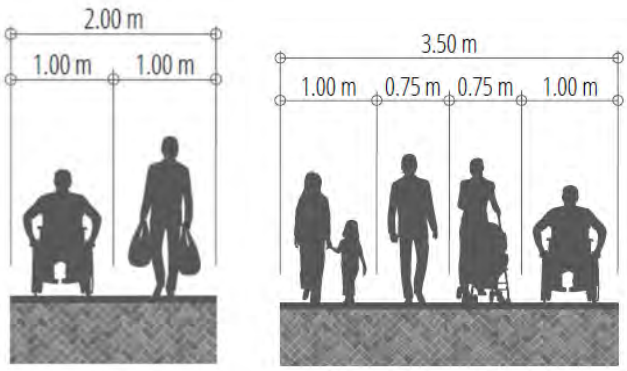
At the following areas/spots, measures for protection of pedestrians should be introduced.

1. Roads where pedestrians have difficulty in crossing due to heavy traffic
2. Intersections where pedestrians have difficulty in crossing due to heavy traffic

b) Improvement Measures of pedestrian circumstances

i. Secure the necessary width for sidewalk

In Tanzania, the minimum sidewalk width is 2.0m. The necessary sidewalk width for sidewalks with many pedestrians requires 3.5m and the usual sidewalk requires 2.0m. Basically, sidewalks shall be installed on both sides of carriageway excluding the low pedestrian demand road of collector road/feeder road/community road. Figure 10.5.13 shows the necessary sidewalk width.



Source: ROAD GEOMETRIC DESIGN MANUAL By MOW, Tanzania 2011

Figure 10.5.12 Concept for Necessary Width for Pedestrian Sidewalk

ii. Installation of facilities for pedestrian

The following facilities are expected to secure the pedestrian's safety and to put flow of pedestrians in order:

- Pedestrian crossing signal on the wide arterial road
- Pedestrian crossing signal at intersection
- Pedestrian overpass on the wide trunk road. Pedestrian overpasses are located at Major BRT Stations (Morocco, Ubungo and Kimara) shown in Photo 10.5.2.

Overpass pedestrian bridge at BRT Morocco Station

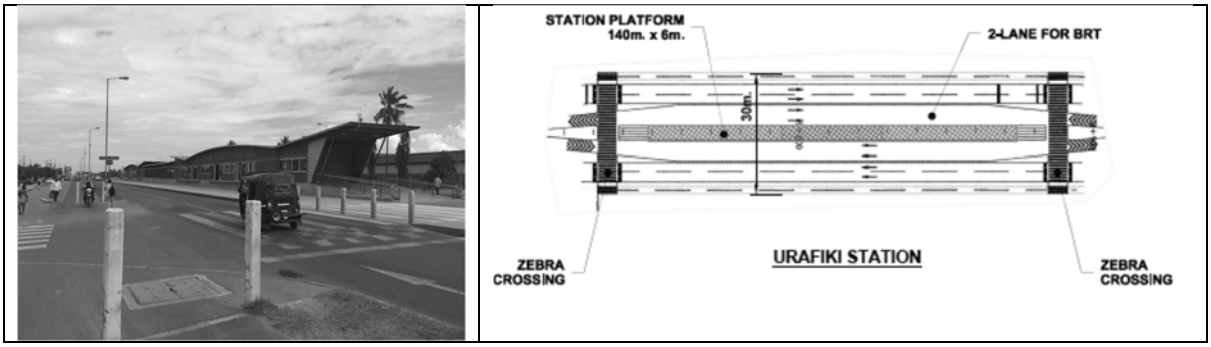
Overpass pedestrian bridge at BRT Kimara Station

Source: JST

Photo - Pedestrian Facilities in DSM

Currently, pedestrian crossing was installed at the BRT station of Phase-1 section (Morogoro Road). If BRT route is installed in other arterial roads such as Bagamoyo Road, Kilwa Road, Nyerere Road, many pedestrian crossings with humps will be installed at each station.

Installation of pedestrian overpass is desirable regarding safety since the pedestrians and vehicles can cross separately. Pedestrian, however, hesitate to use pedestrian overpass due to their hate of climbing up and down the stairs. The safety facility of pedestrian crossing at grade shall be considered.



Source: JST

Figure 10.5.13 Pedestrian Crossing along Morogoro Road

Regarding CBD, JICA CUPID Project conducted a pilot project along Samora Avenue. The contents of the pilot project include wider sidewalks, pedestrian crossings and on-street parking space. "Urban Street Design Guide" was prepared by CUPID including the proposed cross section and countermeasures of major streets in CBD. Streets in CBD area will be improved based on "Urban Street Design Guide".

Wider sidewalk with protected pole- Samora Avenue | Pedestrian crossing non-signalized - Samora Avenue

Source: JST

Figure 10.5.14 Pedestrian Facilities along Samora Avenue (CUPID Pilot Project)

(2) Improvement Plan for Cyclist

a) Objective of Improvement Plan

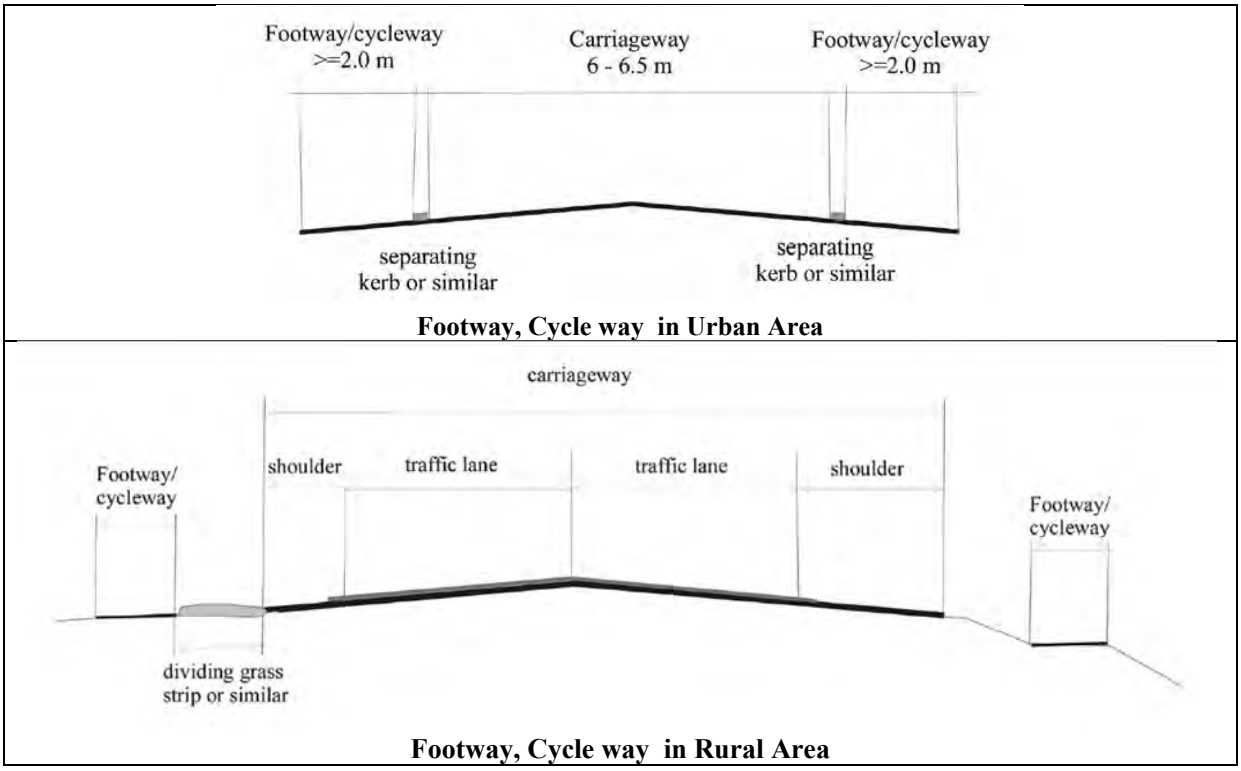
Currently, the traffic volume of bicycle is not large. However, measures for cyclists are necessary for the following aspect:

- With the progress of public transport system, bicycle is one of the important traffic modes in going to stations like bike & ride. Bike parking space shall be installed in the proposed terminal and a bike network will be formulated around terminal area.
- Bicycle is the substitute transport mode for vehicle. By enhancement of bicycle use, the number of motorcycles and passenger vehicle use will be decreased.
- Currently, cyclists are at risk by vehicle traffic and occasionally suffer accident. Measures for protection of cyclist are required.
- On the other hand, as the traffic volume of bicycle increases, collision of bicycle and pedestrian increases. Measures for coexistence of cyclist and pedestrians should be undertaken.

b) Improvement Measures for sidewalk

i. Secure the necessary width for sidewalk

According to the present road geometric design manual by Ministry of Works, footway and cycle way is combined as shown in Figure 10.5.14. Combined footways / cycle ways should be 3.0m wide (2.0m absolute minimum). It is important for footway and cycle way surfaces to be at least as smooth as the adjacent traffic lanes and shoulders.



Footway, Cycle way in Urban Area

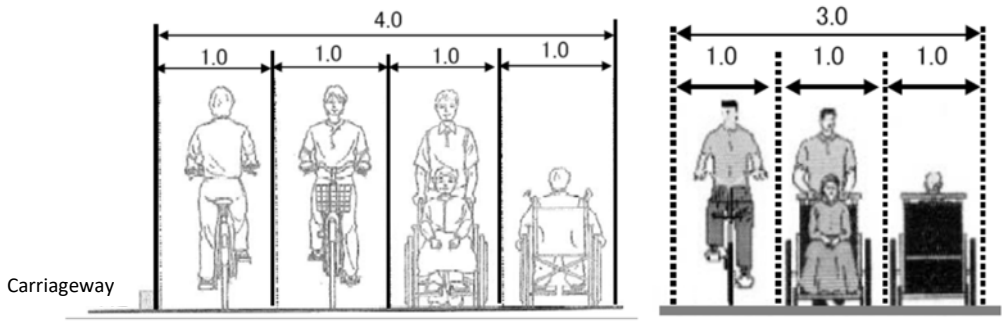
Footway, Cycle way in Rural Area

Source: ROAD GEOMETRIC DESIGN MANUAL By MOW, Tanzania 2011

Figure 10.5.15 Combined Footways /Cycle ways Width

However, for high flows there can be conflicts between cyclists and pedestrians, it is recommended to have wider width. Figure 10.5.15 shows the necessary bicycle and pedestrian sidewalk width, for the sidewalk with many pedestrians, a 4.0m is required and for the usual sidewalk, 3.0m is required.

If in the future, cyclist will increase, exclusive cycle way's installation shall be considered.



Sidewalk with many pedestrians **Usual sidewalk**

Source: Ministry of Land Infrastructure, Transport and Tourism, Japan

Figure 10.5.16 Concept for Necessary Width for Bicycles and Pedestrian Sidewalk

ii. Establishment and enlightenment of cycling rule

For the orderly cycling and coexistence with other modes, rule for cycle should be established and diffused among the people. The following rule should be taken into for the cyclist.

- On the roads which don't have sidewalk with aforesaid necessary width, bicycles should run on the carriageway. In this case, bicycles run at the left side of the carriageway.
- On the roads which have sidewalk with necessary width, bicycles should run at the sidewalk.
- On the sidewalk, pedestrian is given priority. Bicycle should stop when it disturb the pedestrian walk

(3) NMT Plan in CBD

Currently, event such as car free day is not implemented in the Dar es Salaam. This kind of car free day has been implemented in not only the cities of Japan, but also many cities in the other countries.

In order to develop an environmental friendly city in Dar es Salaam, this kind of event is necessary to understand transit-oriented city for citizen.

The following photos show the car free day in Jakarta.

- Jogging
- Marathon, Bicycle event
- Demonstration, etc.

Source: JST

Photo - Car Free Day in Jakarta, Indonesia

10.5.4 Traffic Safety Program

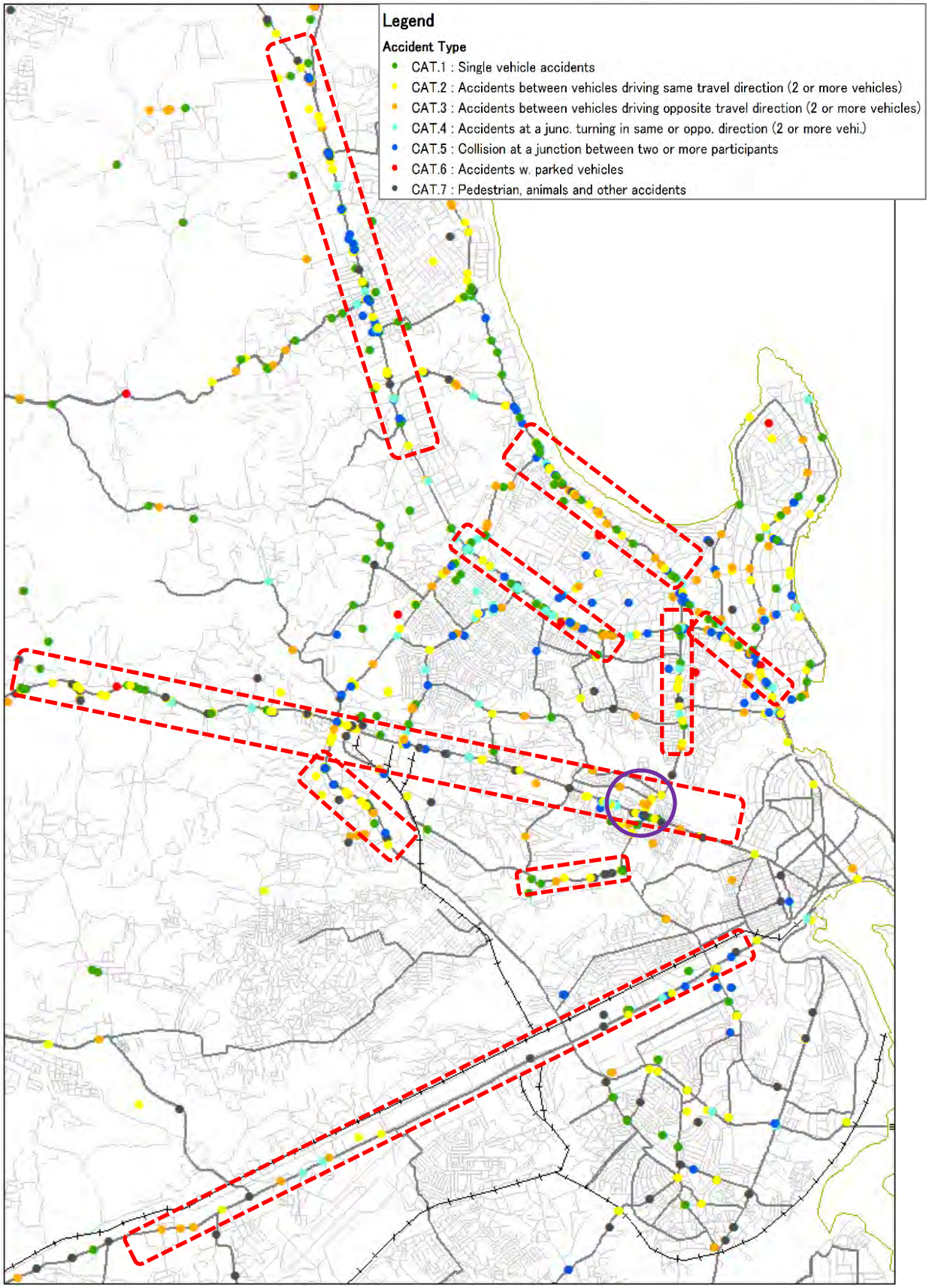
(1) Causes of Traffic Accidents

Some countermeasures for traffic safety are necessary in early stage for the DSM City because traffic accident has been increasing year by year as described in chapter 5.1.5. According to the annual crime report 2016, annual number of traffic accidents in 2016 is 5,719, that means approximately 20 traffic accidents occur in a day. This amount will be increased in the future without any countermeasures. A major cause of the traffic accident is depending on human factor, especially careless driving, careless motorcyclist, and dangerous driving. Ranking of type of traffic accident in 2016 according to the database of traffic accident, RAIS, is shown in the table below. Collision at intersection and rear-end collision are major traffic accident type in DSM. These traffic accident types are caused by carelessness of driver such as "aggressive turning at intersection or suddenly changing lane at cross-section", "not looking ahead carefully", "sudden acceleration" and "stopping suddenly".

Table 10.5.2 Ratio of Traffic Accident type

Total no.=1,626	Collision at Intersection	Rear-end Collision	Single Accident	Collision at Cross-section	Others
Ration of Traffic Accident Type	25%	24%	20%	13%	18%

Source: MOHA, RAIS



Source: RAIS, JST

Figure 10.5.17 Traffic Accident Type and Locations in 2016

Traffic accidents occur along trunk roads which have more traffic. Magomeni intersection along with Morogoro road, purple coloured circle in the Figure xx, is black spot in DSM. Magomeni intersection is located across with BRT and private vehicle, there is complicated intersection, and also this area has been suffering from flooding. A countermeasure for decreasing traffic accident and evacuating/avoiding flooding should be considered for this location.

It is assumed that lack of street light is one of the causes of traffic accident. Trunk road at night time has poor visibility due to shortage of street lights despite of a lot of traffic and pedestrian along the trunk road. According to the RAIS, major traffic accident type is single accident (CAT.1) such as jumping the truck and collision with obstacle. This type of accident occurs due to poor visibility, over speed or both. Trunk road don't have enough guard rail which can separate pedestrian and vehicle, this type of accident is possible to become a cause of increasing accident with pedestrian and vehicle. The number of accident with pedestrian in night time (CAT.7) is not low compared with those of accident in day-time.

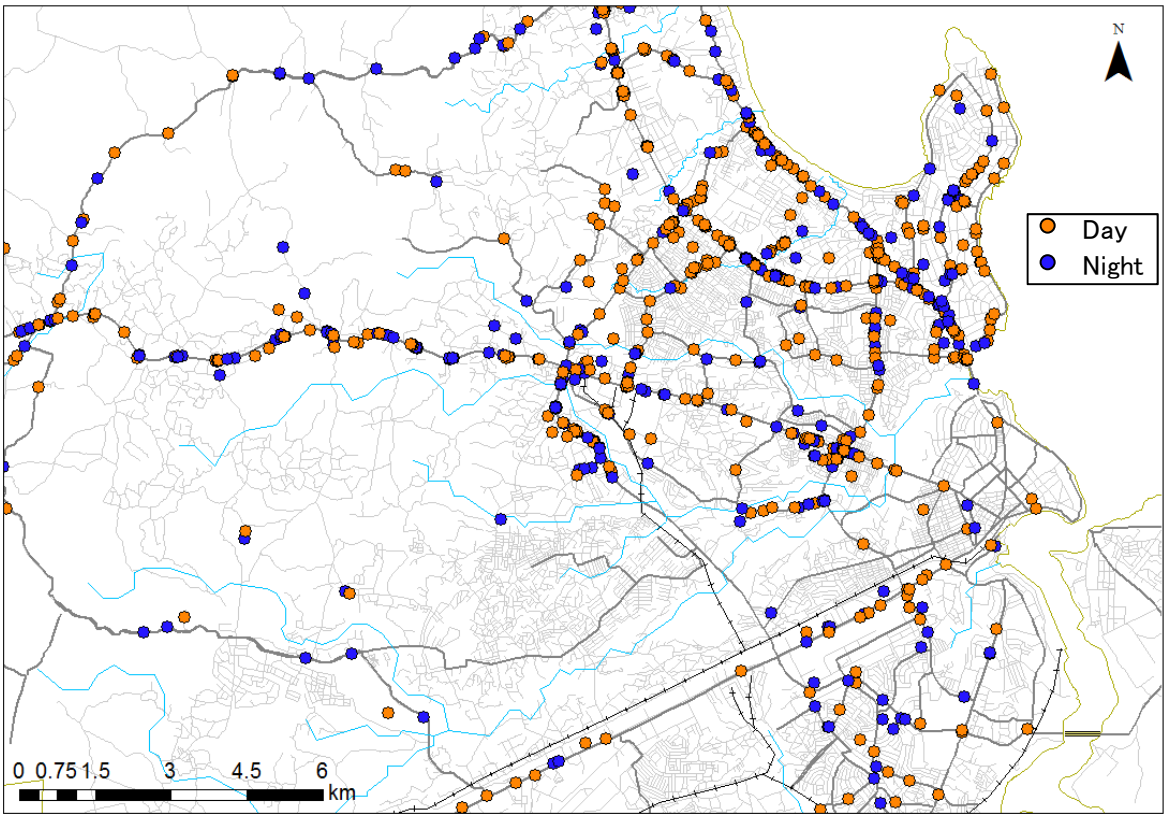
Table 10.5.3 Number of Traffic Accidents by Type

	CAT.1*	CAT.2*	CAT.3*	CAT.4*	CAT.5*	CAT.6*	CAT.7*	Total
Day	157	237	132	105	145	12	159	947
Night	167	150	87	47	104	13	111	679
Total	324	387	219	152	249	25	270	1,626

*: Category of Traffic Accident

CAT.1: Single vehicle accidents
CAT.2: Accidents between vehicles driving same travel direction (2 or more vehicles)
CAT.3: Accidents between vehicles driving opposite travel direction (2 or more vehicles)
CAT.4: Accidents at a junction turning in same or opposite direction (2 or more vehicles)
CAT.5: Collision at a junction between two or more participants
CAT.6: Accidents with parked vehicles
CAT.7: Pedestrian, animals and other accidents

Source: MOHA, RAIS



Source: RAIS, JST

Figure 10.5.18 Traffic Accident in Day-time and Night-time in 2016

(2) Concept of Program

Traffic safety program has two measures, structural and non-structural. Former is removing and avoiding the risk of traffic accident by infrastructure, equipment, and facilities, the latter is improvement of traffic behaviour by education, promotion, and enlightenment. Traffic safety education is important for improving traffic movement and manner. Road user should follow the traffic rules and regulations, and to promote this is effective for traffic management and traffic safety. As mentioned above, the major cause of traffic accident in DSM is by human factor. Therefore, traffic education for improving traffic behaviour is needed in early stage. However, improving mind-set against traffic behaviour by education, promotion, etc. takes some time. To provide incentive to road user is one example of measure for traffic safety education. Preparation of material for traffic safety education such as booklet, reflective plate goods, etc. for children, student, adult, aged person, etc. In addition to this, the conducting promotion campaign to follow of traffic rules and sharing of the information about traffic problems to road users is also important.

Removing traffic accident risk by structural measures should be conducted in parallel. Intersection improvement is one of the countermeasures for reducing traffic accident at intersection of black spots by decreasing conflicts between vehicles. Magomeni intersection has a plan of intersection improvement, and it will decrease traffic accident by vehicles and BRT. For more safety, the separation of pedestrian and vehicle is an effective way of avoiding traffic accident with pedestrians.

For the trunk road, it is necessary for driver to provide caution/warning against driving stream, and also it is needed to physically separate pedestrian and vehicle to remove the risk of accident. Guard rail and road stud is effective for its countermeasure. Some road stud have solar charger, it can be used to enhance their performance even if there is electric power shortage.

Basically, traffic safety program should be conducted with PDCA cycle, and Rode Safety Action Plan should be formulated. Road Safety Action Plan is included in the activity list of road safety related projects. It includes the "what, when, who, and how should be done with each traffic safety projects and programmes". Traffic safety project including traffic safety education should be conducted based on the action plan, therefore JST propose the formulation of road safety action plan in early stage. This project should be taken by some road traffic organizations, mainly MOWTC, DCC, and TANROADS.

(3) Action Plan

Action plan of this project is as follows, and concept map is shown in Figure 10.5.18. In short term, traffic safety action plan should be formulated in parallel with priority measure by structural measures. After implementation of priority project, necessary measure should be considered by concerned organizations based on the traffic safety action plan.

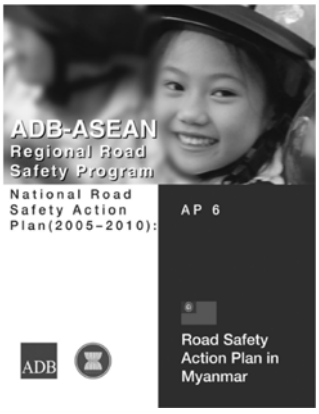
Action 1: Implementation of Priority Measures

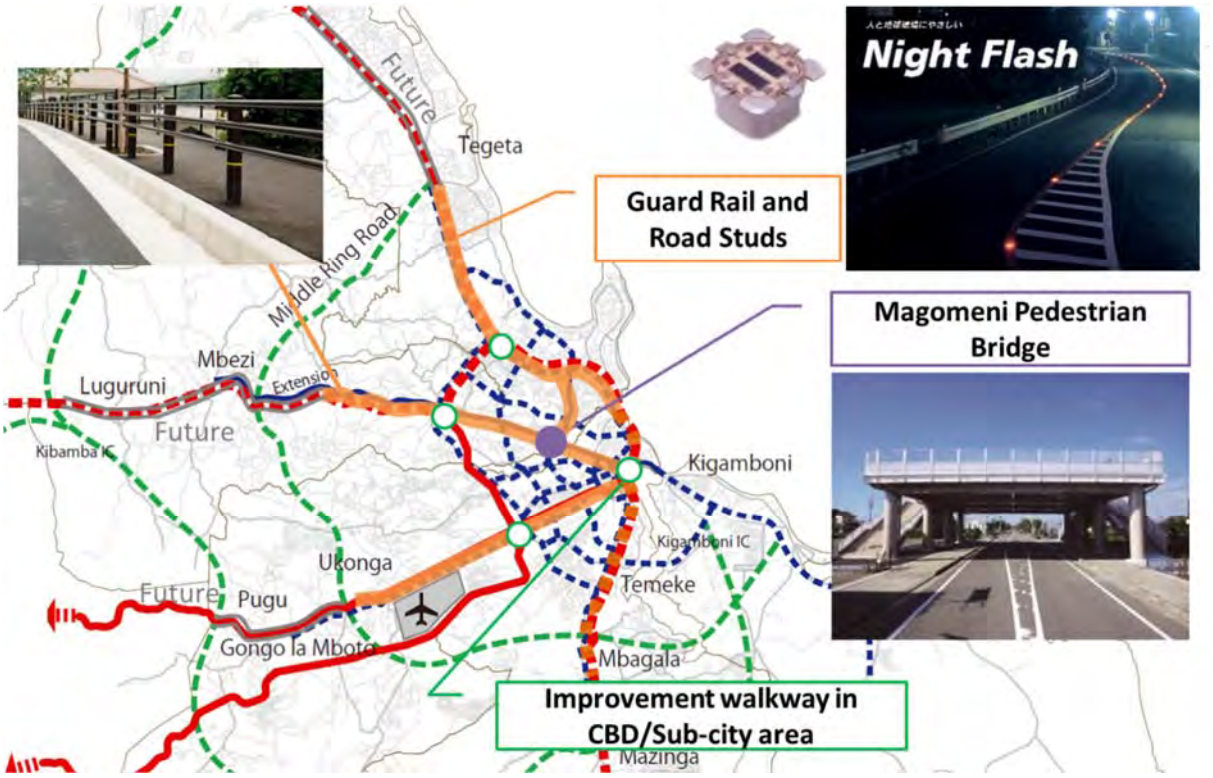
- Countermeasures for Black Spot
  - Pedestrian Bridge at Magomeni Intersection
  - Guard Rail and Road Studs along main corridor (Trunk Road)
- Promotion Campaign
  - Preparation/Distribution of material (goods) for traffic safety/rule for children (student), adult, aged person, etc.
    - Booklet
    - Reflective plate goods
    - Video
  - Training for how-to "drive, crossing, cycling, etc."



Action 2: Formulation of Traffic Safety Action Plan

- 5 Years Plan
- Specify action which should be done by which organization, by when, by what.
- Experience of CUPID project (Samora Avenue etc.) should be utilized in CBD/Sub-centre area.
- Implementation with PDCA cycle



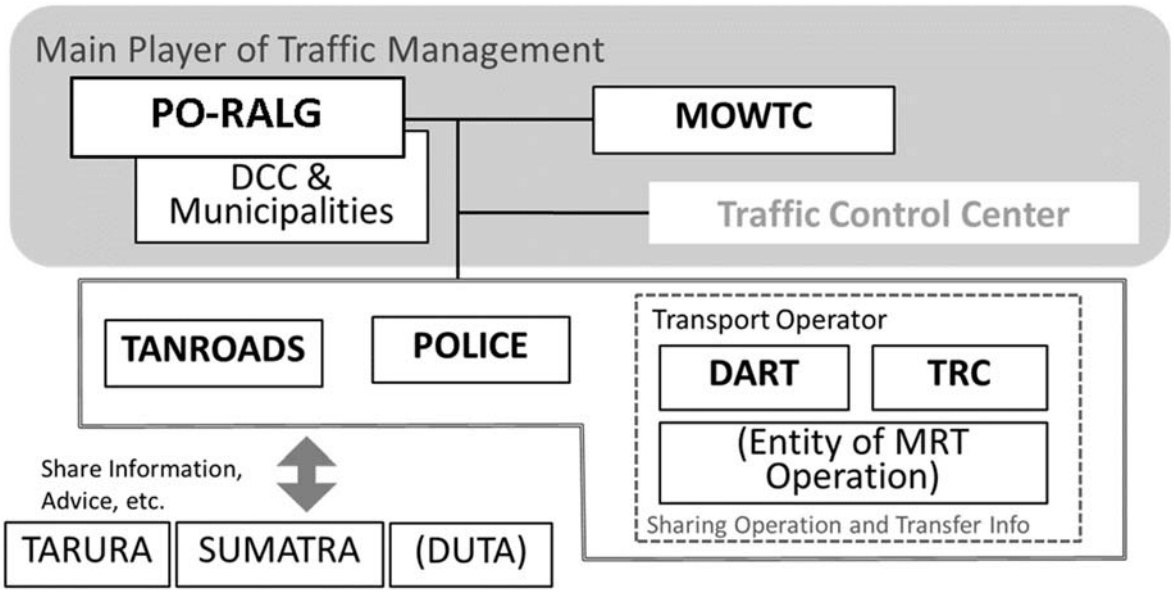


Source: JST, Photo of Road Studs: Tsuji Plastics

Figure 10.5.19 Concept Map of Traffic Safety Program

10.5.5 Recommendation for Demarcation between concerned Organization to achieve output of Master Plan Traffic Management Project

Traffic management including ITS is related with various organizations, and it is necessary to coordinate with a lot of related organization to ensure an effective traffic management project. Therefore, the main player who can lead them should be specified in the early stage. JST and concerned organizations discussed that PO-RALG and MOWTC should be the main players at several meetings (TWG, individual, etc.), because the main player need strong power and capacity of coordination for leading all related organizations. These main players are in the higher level of city and traffic organization, and JST consider that being led by both organizations are suitable for conducting traffic management project. In this master plan project, DCC and each municipality would act under direction from both organization. Traffic Control Centre should be the main function for traffic control, and the main player including DCC and municipalities should manage the traffic control centre. They would share the traffic information and related data with related organizations such as TANROADS, Police, and Public Transport Operator, and also share the information and request advice from TARURA, SUMATRA, and DUTA as needed.



Source: JST

Figure 10.5.20 Responsible Organization of Traffic Management (Suggestion from JST)

10.5.6 Assumed Implementation Schedule of Traffic Management Project in this Master Plan

Assumed implementation schedule is shown in Table 10.5.3. Traffic signal optimization and traffic information provision project would be implemented mainly from short term to middle term. Other project would be also implemented in parallel with both project, but it is important to be coordinated / harmonized with road and public transport project. Traffic safety project should be conducted for the short term because changing people's traffic behaviour and manner needed a long time. Structural measure for traffic safety would be conducted in short term, and traffic education and enlightenment would be conducted as long-time frame project in parallel with this.

Table 10.5.4 Assumed Implementation Schedule of Traffic Management Project

No	Project	～2025	～2030	～2040
Traffic Congestion Plan Including ITS				
Component 1: Mobility Management				
1	Promoting Modal Shift	Prepare Action 1 Prepare Action 2 (Coordinate with Public Transport Project) Action 3 (Coordinate with Public Transport Project)		
2	Parking Management	Action 1 (Including Study and Arrangement) Prepare Action 2 Prepare Action 3		
3	Measure for Improvement Mobility	Action 1 Prepare Action 2		

Component 2: Improvement of Traffic Circulation		
4	Traffic Signal Optimization	Action 1 Action 2 Action 3 Action 4 As needed
5	Intersection Improvement	Action 1 Prepare Action 2 (As needed based on the traffic situation)
6	Area Restriction for Truck and Car	Action 1 Action 2
7	Real-time Traffic Information Provision	Action 1 Action 2 Action 3
Traffic Safety Program		
8	Traffic Safety Program	Action 1 Action 2 (Revise every 5 years)

Source: JST

Table 10.5.5 Proposed Project Lists for the Traffic Management

No.	Name of Project	Length Area,	Section Place	Term	Project Cost (Billion TZS)	Implementation Body	Notes
1	Promoting modal shift	City area	Whole	Short	6.2	DCC, Municipalities	Promotion and Advertisement
				Medium	0.2		
				Long	0.1		
2	Parking Management	City area	CBD, Sub Centre, District Centre, Satellite City	Short	1.0	DCC, Municipalities	Study
				Medium	2.5		Construction
3	Measures for Mobility Improvement	City area	Whole	Short	0.2	DCC, Municipalities	Event
				Medium	0.2		
4	Traffic Signal Optimization	Strategic Traffic Management Area	CBD, main intersections	Short	28.0	PO-RALG, MOWTC, DCC, Municipalities	Construction of Traffic Control Centre, Traffic Signal control system, O&M
		Traffic Management area	CBD, main intersections	Medium	21.0	PO-RALG, MOWTC, DCC, Municipalities	Additional Traffic Signal, O&M
		Traffic Management area	CBD, main intersections	Long	18.0	PO-RALG, MOWTC, DCC, Municipalities	Additional Traffic Signal, O&M
5	Intersection Improvement	Mentioned in the Road Plan					
6	Area Restriction for truck and car	City area	Whole	Short	1.0	MOWTC, DCC, Municipalities	Study

No.	Name of Project	Length Area,	Section Place	Term	Project Cost (Billion TZS)	Implementation Body	Notes
7	Real-time Traffic Information Provision	City area	Whole	Short	47.6	PO-RALG, MOWTC, DCC, Municipalities	ITS MP Study, Installation of Information Provision system
			Whole, Middle Ring Road	Medium	32.0	PO-RALG, MOWTC, DCC, Municipalities	Installation of Information Provision system, Installation of SMARTWAY system
8	Traffic Safety Program	City area	Whole, Main Road	Short	8.13	MOWTC, DCC, Municipalities, TANROADS	Traffic Safety Action Plan, Construction of Pedestrian Bridge, Installation of Guard Rail and Road Studs, Publication for traffic manner improvement
				Medium	2.7	DCC, Municipalities, TANROADS	Installation of Guard Rail, Marking and Road Studs, Publication for traffic manner improvement
				Long	5.4	DCC, Municipalities, TANROADS	Installation of Guard Rail, Marking and Road Studs Publication for traffic manner improvement
Total					**174.23**		