CHAPTER 4 CURRENT LAND USE SITUATION AND ISSUES

4.1 Outline of Land Use in Dar es Salaam City

4.1.1 Historical Growth in DSM (population, GDP etc.)

(1) Population Growth in DSM

It is manifested that people tend to concentrate to DSM for the past 34 years from 1978 to 2012 as shown in Chapter 2. DSM consists of five administrative municipal councils that are: Kinondoni, Ubungo, Ilala, Temeke, and Kigamboni. In 2016, it used to consist of three municipal councils: Kinondoni, Ilala, and Temeke. National Housing Census so far carries the data for three municipal councils. JST still cannot obtain ward-level data for National Housing Census 1978, 1988, and 2002. JST shows the population trend for the three municipal councils in Table 4.1.1.

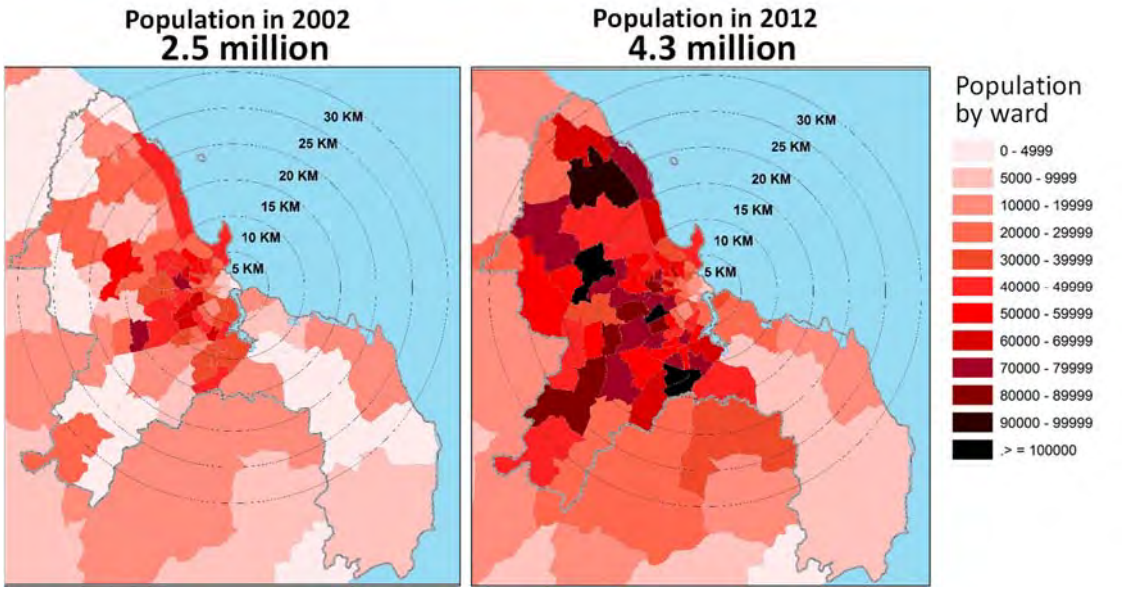
Between 1978 and 1988, the average growth rate in Kinondoni Municipal Council was the highest. Ilala and Temeke Municipal Councils marked highest growth of 4.7% between 1988 and 2002. Between 2002 and 2012, population in Ilala Municipal Council grew at a rate of 6.8%, followed by 5.9% in Temeke Municipal Council and 5.1% in Kinondoni Municipal Council. Recently, population growth in Ilala Municipal Council is higher than other municipalities. It implies that population has been growing faster at the western part of the city.

Table 4.1.1 Population Trends by Municipal Councils in DSM, 1978, 1988, 2002, and 2012

Municipal Council	Population				Average Annual Growth Rate		
	1978	1988	2002	2012	(1978-1988)	(1988-2002)	(2002-2012)
Kinondoni	364,706	627,416	1,083,913	1,775,049	5.6%	4.0%	5.1%
Ilala	228,235	331,663	634,924	1,220,611	3.8%	4.7%	6.8%
Temeke	258,851	401,786	768,451	1,368,881	4.5%	4.7%	5.9%
Total	851,522	1,360,865	2,487,288	4,364,541	4.8%	4.4%	5.6%

Source: National Housing Census 1978, 1988, 2002, and 2012

Figure 4.1.1 shows the population distribution of DSM in 2002 and 2012. There are areas on the line with higher population especially along Bagamoyo Rd, Morogoro Rd, Nyerere Rd and Kilwa Rd. Suburban areas with more than population of 100,000 persons are found at over 15km from the CBD in 2012.

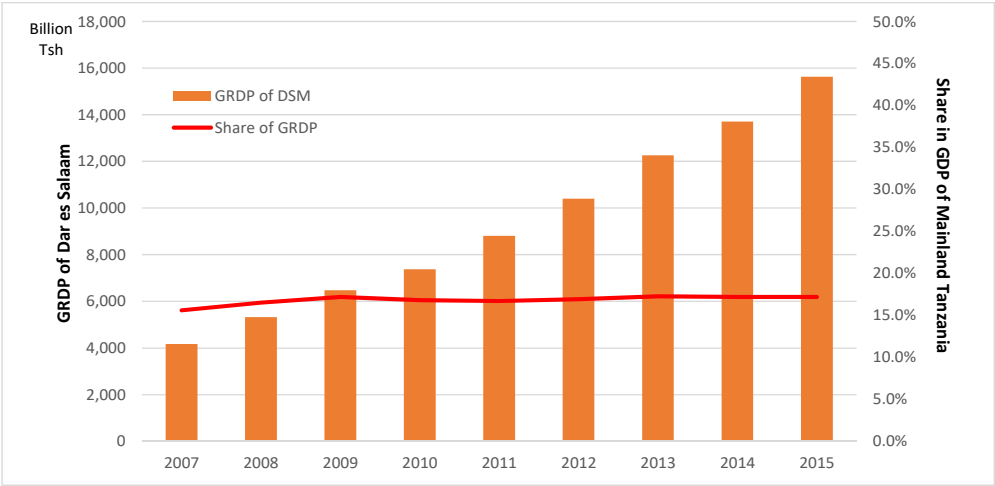


Source: JST based on National Housing Census 2002, and 2012

Figure 4.1.1 Trend of GRDP in DSM

(2) Regional GDP Growth in DSM

Regional GDP (GRDP) in DSM has grown year by year and maintained the share in GDP of mainland Tanzania at between 15% and 17%. As shown in Figure 4.1.2, DSM generated 4,174 billion TZS in 2007 and 15,631 billion TZS in 2015, according to the regional GDP at current market price in National Accounts of Tanzania Mainland 2007–2015, NBS. The share of GRDP in DSM in GDP of Mainland Tanzania these nine years was between 15.6% and 17.2%. The price of GRDP is a nominal GRDP including the factor of inflation.



	2007	2008	2009	2010	2011	2012	2013	2014	2015
GRDP of DSM	4,174,004	5,329,061	6,484,117	7,368,793	8,807,745	10,402,309	12,259,974	13,711,568	15,631,679
GDP Mainland	26,770,432	32,248,628	37,726,824	43,836,018	52,762,581	61,434,214	70,953,227	79,718,416	90,863,681
Share in GDP of Mainland Tanzania	15.6%	16.5%	17.2%	16.8%	16.7%	16.9%	17.3%	17.2%	17.2%

Source: National Accounts of Tanzania Mainland 2007 – 2015, NBS

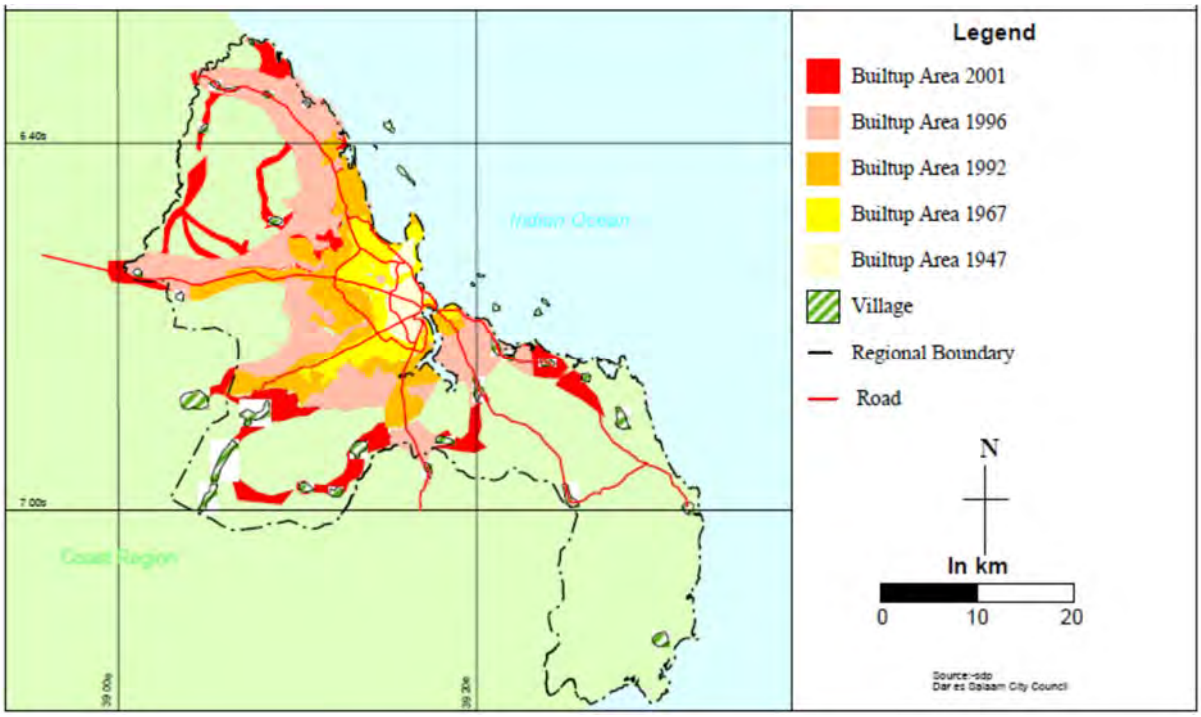
Figure 4.1.2 Trend of GRDP in DSM

4.1.2 Expansion of Urbanized Area

The urbanized area in DSM was first formed at the City Centre in the early 1860s, and it has gradually expanded along the major arterial roads such as Bagamoyo Road, Morogoro Road, Nyerere Road, and Kilwa Road to this date.

DSM has experienced significant growth since its foundation in the early 1860s. DSM declared a township in 1920 and it was designated as a municipality in the British Colonial period in 1949. When Tanzania became independent in 1961, DSM became a city and later it became the capital of Tanzania. Although the capital moved to Dodoma in the 1970s, DSM City has continuously served as a centre of transport, business, commercial and cultural activities in the country.

As shown in the urban growth pattern after 1947 (Figure 4.1.3), urban area has expanded significantly along the coastline and the major arterial roads including Bagamoyo, Morogoro, Nyerere and Kilwa Road, resulting into a mono-centric and radial development pattern. Until the 1940s, the built-up area was only limited to the area within a 5km radius from the City Centre. Most of the central and local government administrations as well as private businesses and commercial functions were all concentrated at the city centre.



Source: Strategic Urban Development Plan

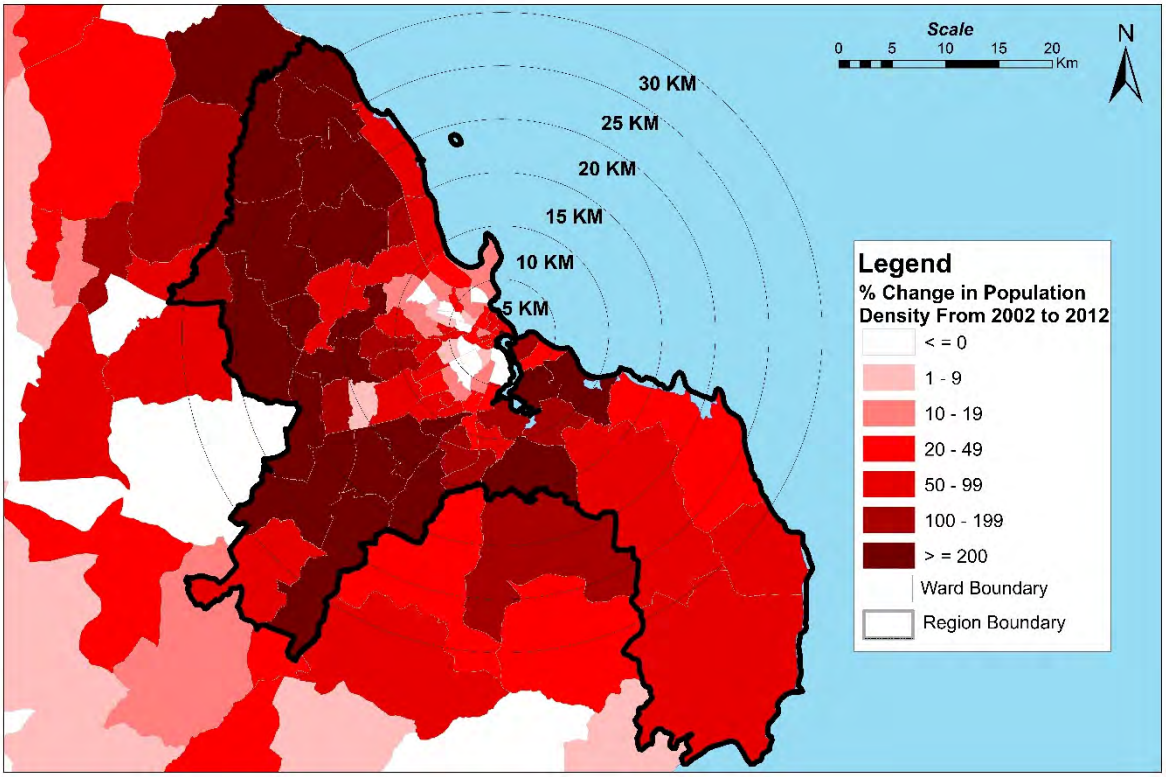
Figure 4.1.3 City Expansion 1947-2001

In the 1950s and 1960s, built-up area expanded to the area with about 10km radius from the City Centre. In this period, rapid population growth was seen in the areas of Mikocheni and Kijitonyama along Bagamoyo Road, Sinza and Ubungo along Morogoro road, Tandika along Kilwa Road, and Kiwalani along Nyerere Road. Major industrial sites were developed along Nyerere road.

For the next two decades in the 1970s and 1980s, the city experienced rapid urban expansion and population growth. The built-up area expanded to the areas within nearly 20km radius from the city centre, especially along the major arterial roads. Since the 1990s, urban expansion or sprawl accelerated in the outskirts of the city, and development activities have extended to the areas with nearly 30km radius. After that, DSM has continued expanding and became denser after 2002 as

shown in Figure 4.1.4. Population density at northwestern and southwestern areas of DSM between 20km and 30km had become more than double. Population density at inner city within a 10km radius also increased, but the change is less than 50% and the degree of the change is smaller than northwestern and southwestern areas between 20km and 30km.

Water area, where DSM port is located, separated the city centre and Kigamboni for a long time. Mwalimu Nyerere Bridge (Kigamboni Bridge), newly constructed in 2016, improves the access between CBD and Kigamboni, but encouraging development will be difficult because lowlands are lying in Kigamboni.



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

Figure 4.1.4 Change in Population Density from 2002 to 2012

4.1.3 Population Distribution and Density

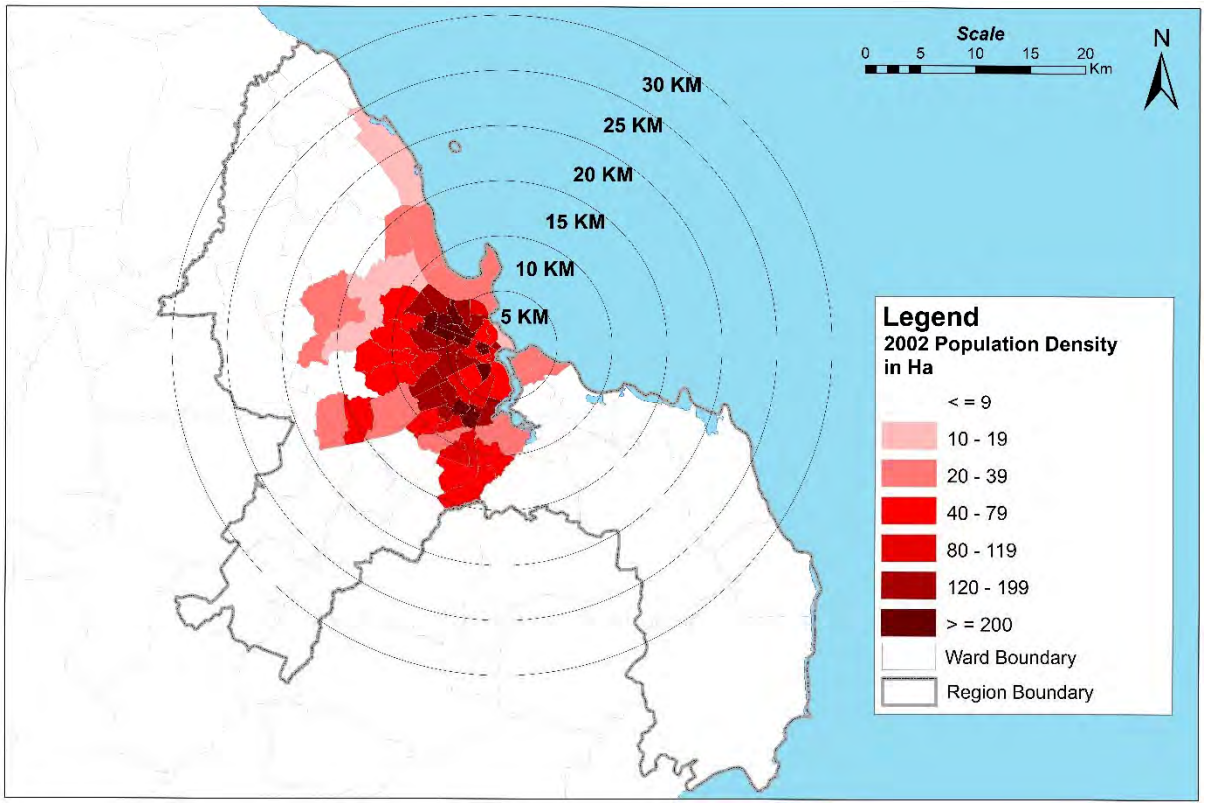
Population density in DSM as of 2012 was 3,087 persons/km^2. Among the five municipal councils in DSM, population density of Temeke Municipal Council is 83.17 persons/ha and the highest, and population density of Kigamboni Municipal Council is 3.21 persons/ha and the lowest as shown in Table 4.1.2. As shown in Figure 4.1.4 above, population density at northwest and southwest areas of DSM between 20km and 30km had increased more than double for 10 years between 2002 and 2012.

Table 4.1.2 Population Density by Municipal Council

Municipal Council	Number of Wards	Population (persons)	Land Area (km^2)	Population Density (persons/km^2)	Population Density (persons/ha)
Kinondoni	20	929,681	270	3,443	34.43
Ubungo	14	845,368	261	3,239	32.39
Ilala	26	1,220,611	210	5,812	58.12
Temeke	21	1,205,949	145	8,317	83.17
Kigamboni	9	162,932	507	321	3.21
DSM	90	4,364,541	1,393	3,087	30.87

Source: JST based on Population and Housing Census 2012

Figure 4.1.5 shows population density by ward in DSM as of 2002. High density areas more than 120 persons/ha were distributed between 5km to 10km radius from city centre. Beyond a 10km radius of the city centre, the areas along Kilwa Road are fairly highly populated with the population density of 40 and 119 persons/ha. The population density, at most of the areas beyond 15km radius from the city centre, is very low at less than 9 persons/ha.

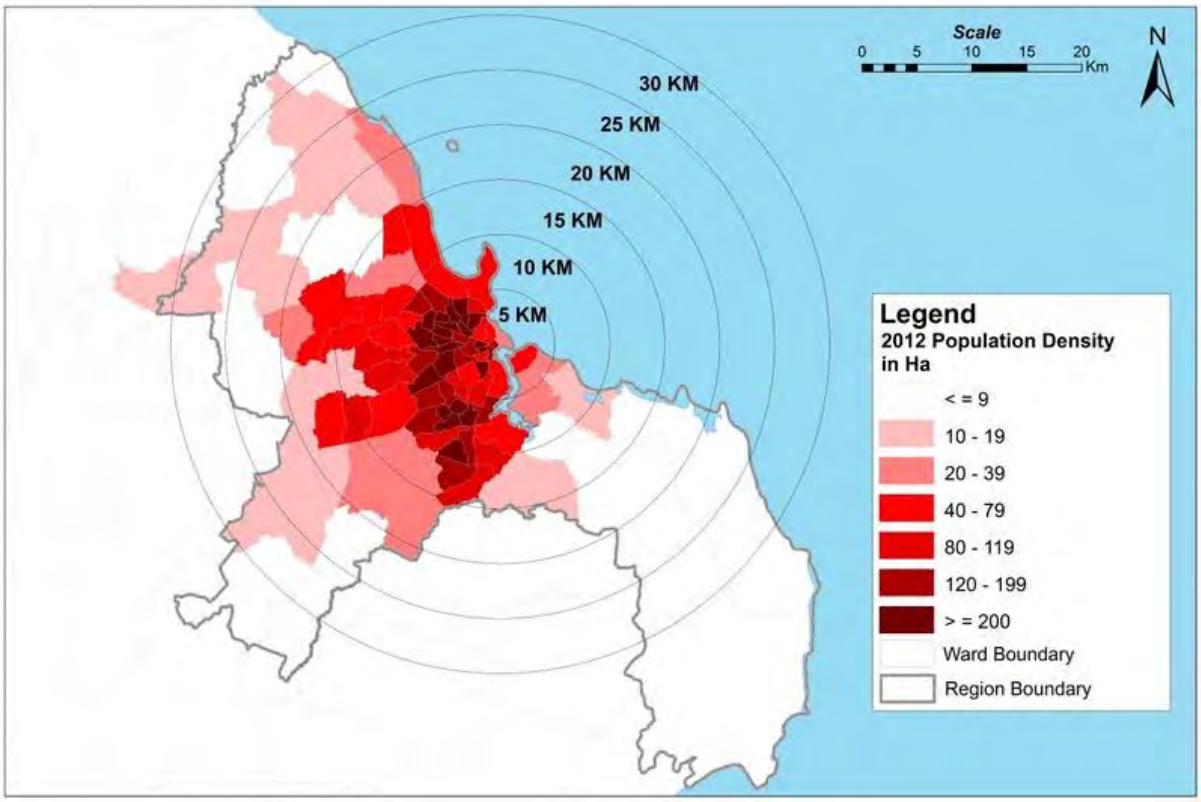


Source: JST based on Population and Housing Census 2002

Figure 4.1.5 Population Density by Ward in DSM in 2002

Figure 4.1.6 shows population density by ward in DSM as of 2002. High density areas tend to expand to northwest, west, and southwest. Especially population density, at wards located 5km to 10km radius from city centre to these three directions, are high at more than 120 persons/ha.

Wards located 10km to 15km also have fairly high population densities of 40-79 persons/ha. The figure implies that population density tends to be high along the main arterial road such as Bagamoyo Road, Morogoro Road, Nyerere Road, and Kilwa Road. Population density at the south-eastern part of the city such as Kigamboni is less than 9 persons/ha and low.



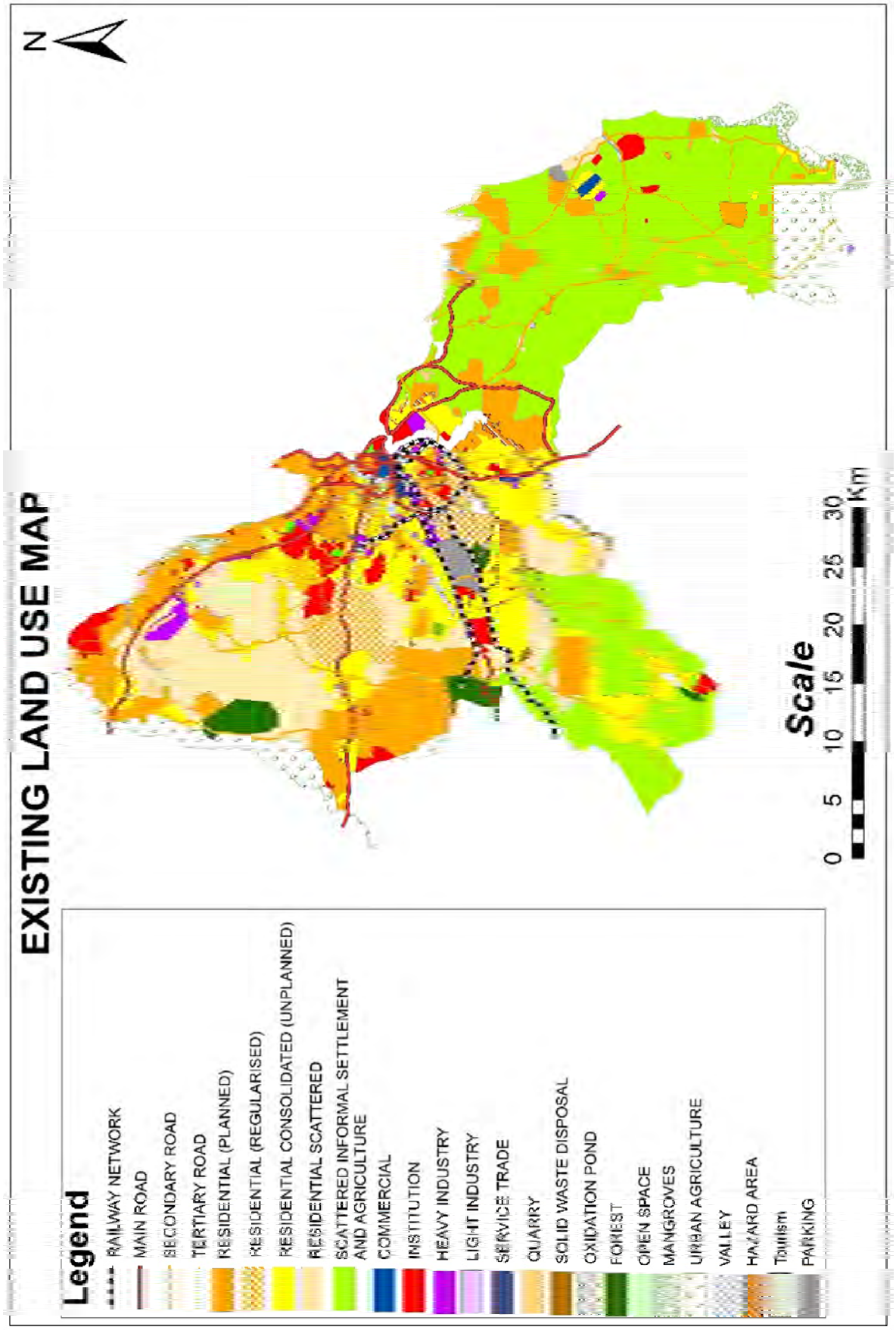
Source: JST based on Population and Housing Census 2012

Figure 4.1.6 Population Density by Ward in DSM in 2012

4.1.4 Distribution of Function, CBD, Sub-centre and Industrial Area

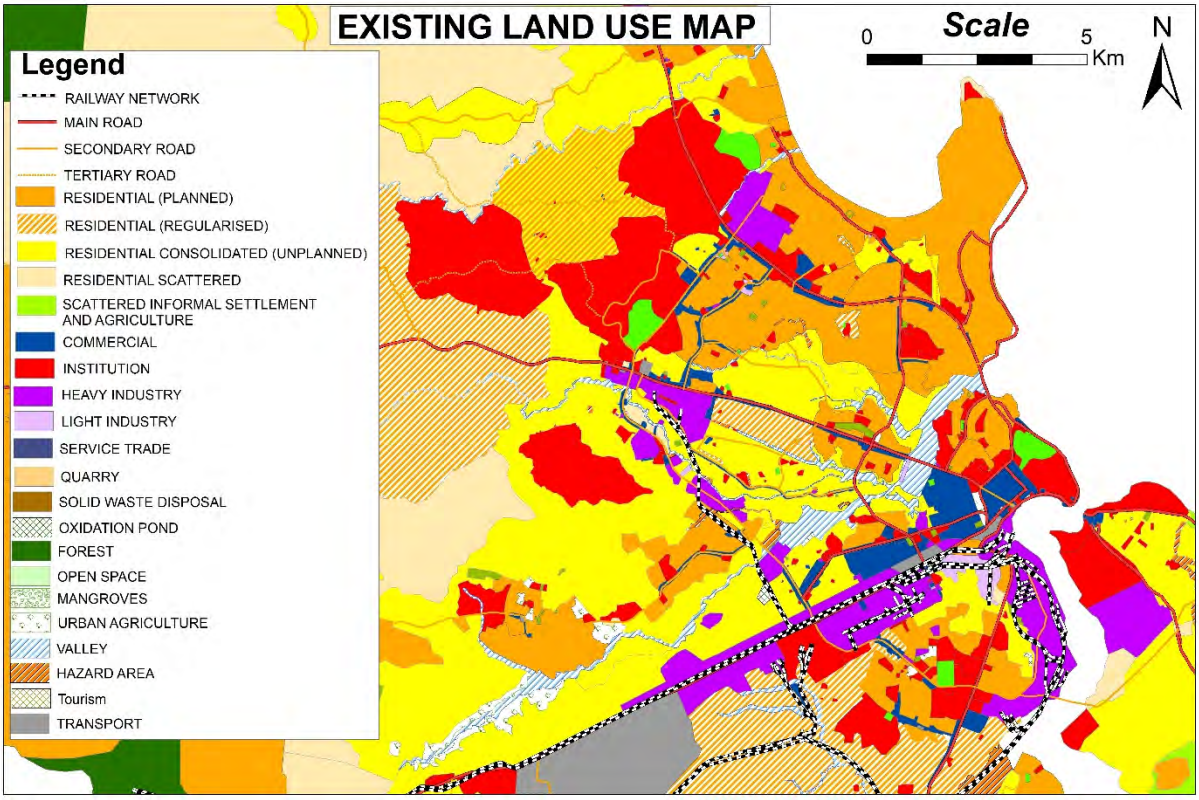
DSM has variety of urban functions including residential, commercial, industrial, institutional uses as the largest city in the United Republic of Tanzania. Most of urban activities in DSM can be seen at Central Business District and along the major arterial roads such as Bagamoyo Road, Morogoro Road, Nyerere Road, Kilwa Road, and Nelson Mandela Road. Urban activities are still not active in western edge and south-eastern part of the City. Figure 4.1.7 and 4.1.8 show the existing land use of the city as of 2016 prepared by Ministry of Lands, Housing and Human Settlements Development.

Figure 4.1.9 shows share of each land use category of existing land use in DSM. Residential occupies 49.2% of the whole land of DSM, followed by Scattered Informal Settlement and Agriculture (33.2%). The share of transport such as roads is only 0.8%.



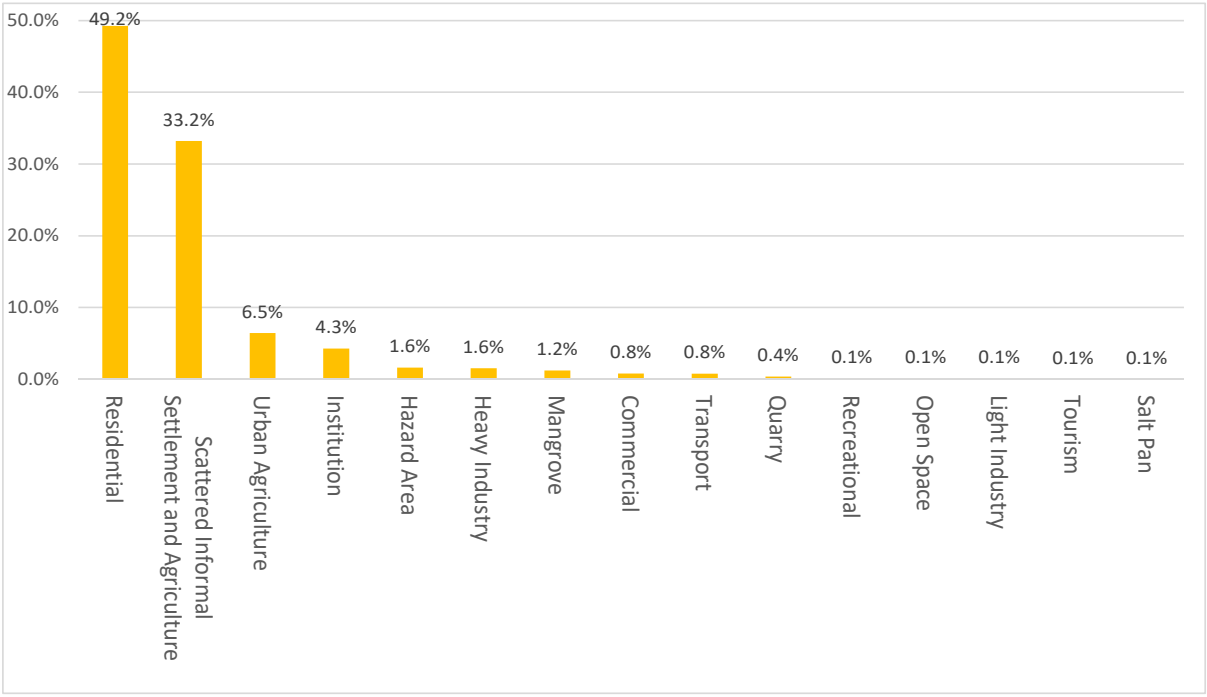
Source: Ministry of Lands, Housing and Human Settlements Development

Figure 4.1.7 Existing Land Use of DSM as of 2016



Source: Ministry of Lands, Housing and Human Settlements Development

Figure 4.1.8 Existing Land Use of DSM as of 2016 (Zoomed)



Source: Ministry of Lands, Housing and Human Settlements Development

Figure 4.1.9 Share of Each Land Use Category in Existing Land Use as of 2016

(1) Residential Area

Residential area is widely expanded at north-western, western, and south-western parts of the city as shown with the red lines in Figure 4.1.7. Western edge and south-eastern part of the city are mainly scattered informal settlement and agriculture which is generally low dense land use. Planned residential area mainly stretches to northwest at eastern side of Bagamoyo Road. Unplanned residential area is distributed mainly at western and south-western part of the city.

(2) Commercial area

Most of commercial activities are concentrated in the city centre and distributed along major arterial roads. Shopping malls such as Milimani City Shopping Mall can be seen along Nelson Mandela Road. Small-scale informal commercial and trading activities can be seen along major arterial roads as well as in the unplanned settlements.

(3) Industrial area

Industrial area in DSM is located along TRC line and Nyerere Road in Ilala Municipal Council and Temeke Municipal Council; at Ubungo and Mwenge; at northwest part of Kigamboni; and northwest part of Kinondoni Municipal Council near Bagamoyo Road.

(4) Institution

Institutional lands are scattered in the city. National government buildings are built in the high density area of the city centre. Large compounds of institutional use can be seen near Ubungo and Kigamboni such as a campus of University of DSM and at Kigamboni such as a campus of Mwalimu Nyerere Memorial Academy.

(5) Other uses

Other land uses including open spaces, urban agriculture, and forest reserves can be seen in the city. Urban agricultural land can be seen at the north and south edge of the city. The share of forest area in DSM is very small. Pande Game Reserve is located in Kinondoni Municipal Council and Pugu Forest Reserve is located in Ilala Municipal Council. Pugu Forest Reserve is the source of the Msimbazi river. Both reserves have endemic plant species, mammalian endemic species, and endemic subspecies of birds.

4.1.5 Social Facility Distribution in DSM

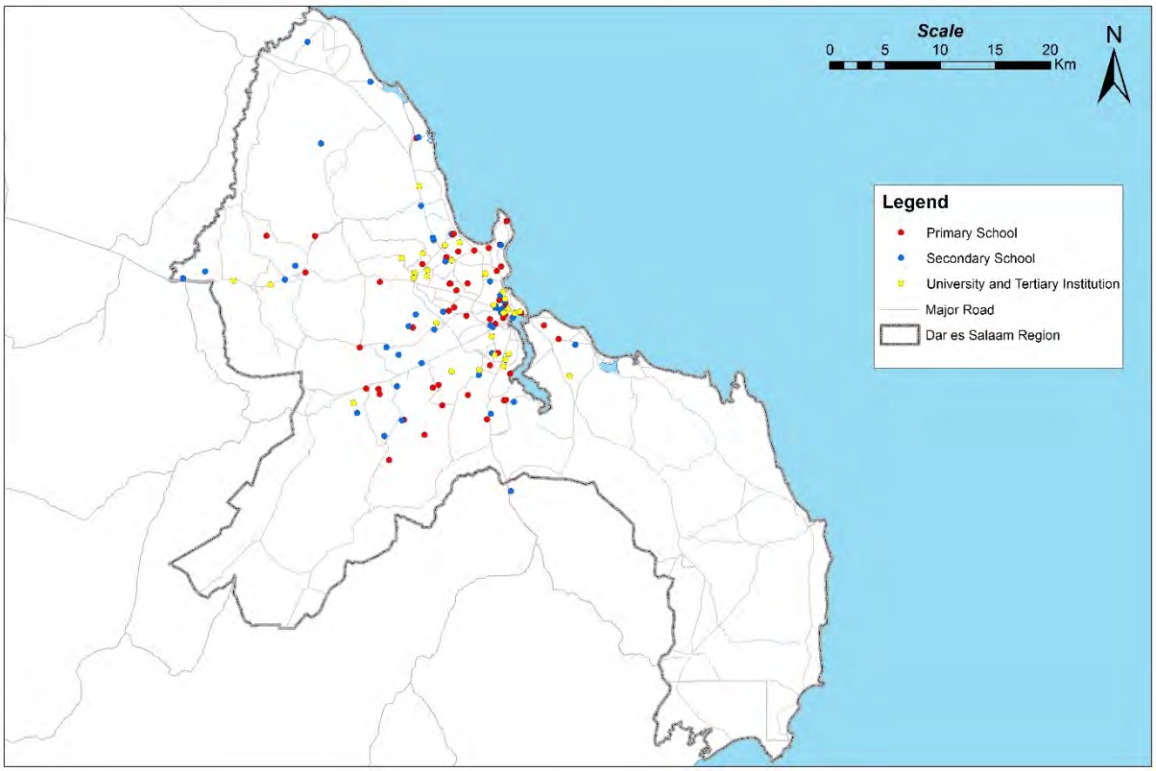
Social facility includes educational facilities, health facilities, and sports and cultural facilities. The residents visit these facilities in their daily life and generate trips, so the location and scale of these facilities are to be grasped in the study. JST will collect further information on social facilities such as land area and number of people.

(1) Education

Education facilities are primary schools, secondary schools, high schools, and colleges and universities. The distribution of the educational facilities is shown in Figure 4.1.10. Many schools are located within a 10km radius from the city centre or within Nelson Mandela Road. The number of schools is very small in Kigamboni Municipal Council. JST will collect data on number of students for each school and location.

Table 4.1.3Table 4.1.3 shows the major universities in DSM. Key information such as land area and number of enrolled students are not completed in the table, JST will collect further information on it. Most of the major universities are located at northern or western part of the city such as Ubungo

Municipal Council and Kinondoni Municipal Council. Open University of Tanzania is now located at 5km north from the city centre, but the headquarters of the university will move to Kibaha district in Pwani Region which is out of the city. Mloganzila Campus of Muhimbili University of Health and Allied Sciences and University of DSM have large campuses of more than 600 ha.



Source: JST extracted data from Google Earth

Figure 4.1.10 Distribution of Schools in DSM

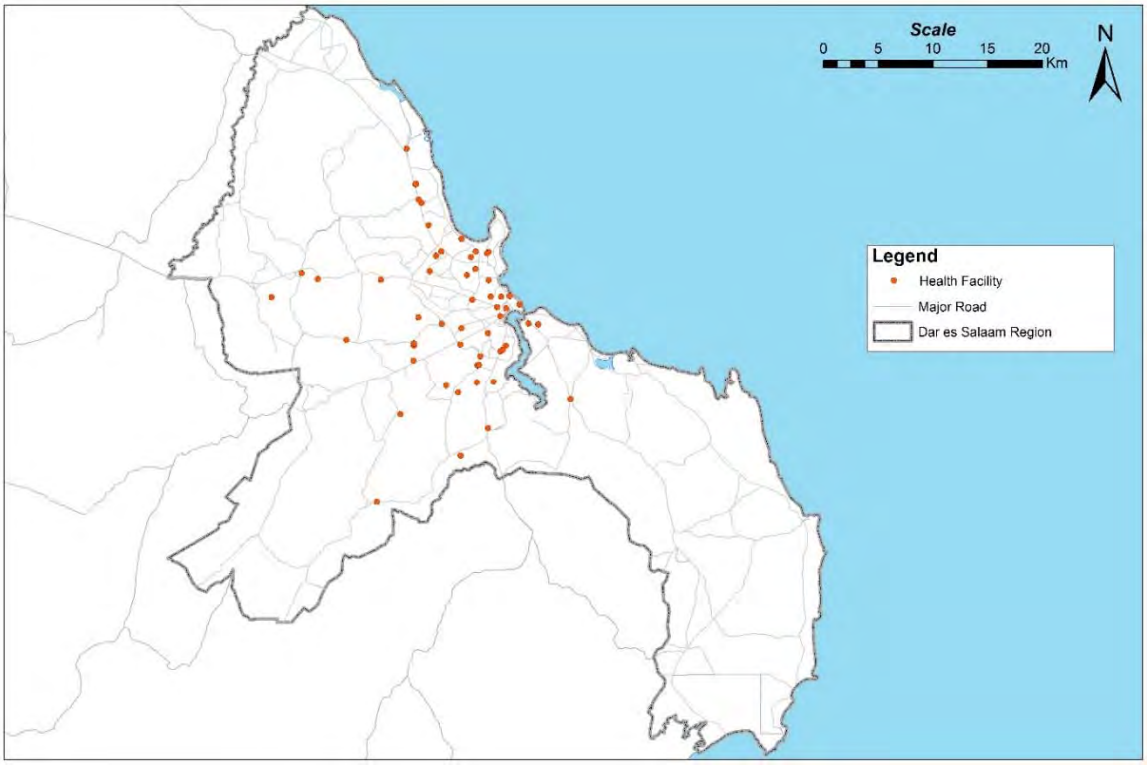
Table 4.1.3 List of Major Universities in DSM

Name of University	Location (Municipal Council)	Access Road/Street	Distance from City Centre	Land area (ha)	Number of Enrolled Students
University of DSM	Ubungo	Nelson Mandela Rd.	10 km	658 ha	16,400 undergraduate and 2,700 postgraduate students
Ardhi University	Ubungo	Nelson Mandela Rd.	10 km	N/A	2,457 undergraduate and 156 postgraduate
Muhimbili University of Health and Allied Sciences Muhimbili Campus	Ilala	Morogoro Road	2 km	N/A	N/A
Muhimbili University of Health and Allied Sciences Mloganzila Campus	Ubungo	Morogoro Road	26km	1,500 ha	N/A
Open University of Tanzania	Kinondoni	New Bagamoyo Road	5 km	N/A	44,099
The Hubert Kairuki Memorial University	Kinondoni	New Bagamoyo Road	7 km	N/A	N/A
International Medical and Technological University	Kinondoni	New Bagamoyo Road	15 km	N/A	1,000 students
Kampala International University	Ilala	Nyerere	16 km	40 ha	N/A

Source: Website of each university
Note: N/A stands for Not Available

(2) Health

Health facilities are hospitals and clinics. Figure 4.1.11 shows the distribution of health facilities. Many facilities are located along New Bagamoyo Road and most of the facilities are located within a 15km radius from the city centre. JST will collect further information on names of the facilities, locations, and number of beds.

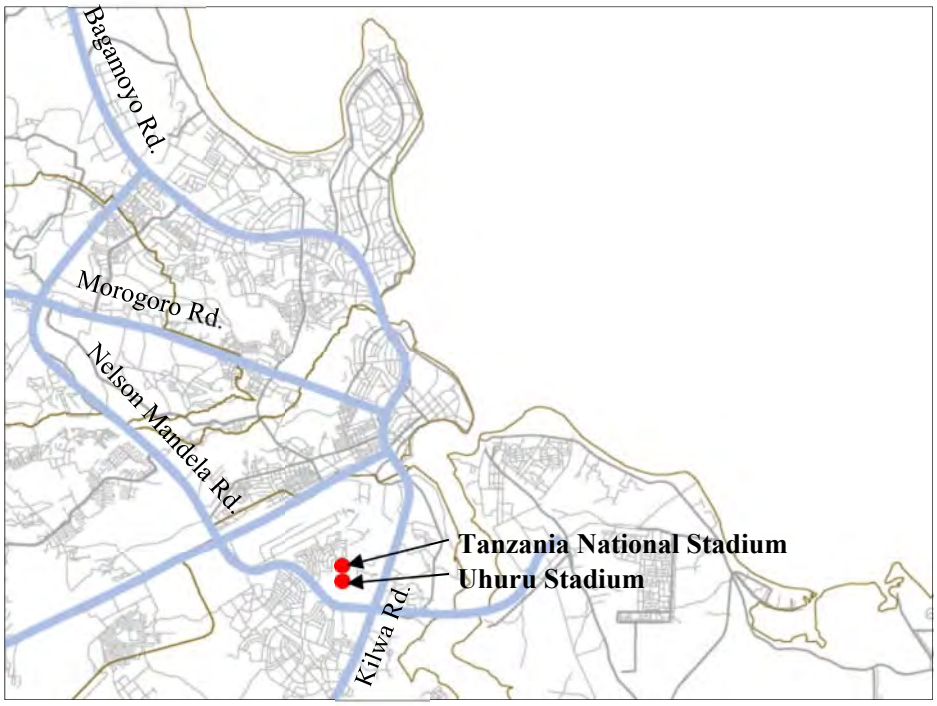


Source: JST extracted data from Google Earth

Figure 4.1.11 Distribution of Health Facilities in DSM

(3) Sports

The representative sports facilities in DSM are the compound of Tanzania National Stadium and Uhuru Stadium. The compound is located at Temeke Municipal Council near the intersection of Kilwa Road and Nelson Mandela Road as shown in Figure 4.1.12. Tanzania National Stadium has the capacity of 60,000 people and Uhuru Stadium has the capacity of 23,000. Construction of an indoor stadium, warm-up ground and a sports village/college in the compound is planned.



Source: JST

Figure 4.1.12 Location of Stadiums in DSM

4.2 Issues on Land Use

Major urban functions and activities concentrate in the city centre and urbanized area expands along the major arterial roads and rail roads. The urbanized area expands to north-west, west, and south-west due to geographical constraints. The east side of DSM faces the Indian Ocean and the city centre faces water area of the DSM port. The ocean and the water area has discouraged developments in Kigamboni.

This trend has continued up to date and mono-centric urban structure has formed. This urban structure causes the loss of agricultural lands, forests and open spaces between the major arterial roads through expansion of densely populated areas. It has also lead to traffic congestion and deterioration of the urban environment.

As mentioned in subsection of 4.1, the urbanized area in DSM tends to expand. The increasing rate of population density along the major arterial roads over 20km radius from the city centre is fairly high. Residential area tends to expand to the hilly area at the northern and western part of the city.

The land area of unplanned residential area and informal settlement is fairly large. These areas expand compared to the planned residential area. Generally, residents in these areas cannot receive sufficient public services such as water supply, power supply, etc. The areas also expand to formerly open spaces, green areas, and forest areas. This has negative impacts to disaster risks reduction by changing local climate and runoff of river flows. The insufficient drainage capacity in the city is one of the vulnerabilities in disaster risk reduction, so this trend of urban growth makes disaster risk in the city higher and has risks to damage roads and urban transport system.

CHAPTER 5 CURRENT TRANSPORT SERVICE AND ISSUES

5.1 Transport System and Level of Service

5.1.1 Overview of Transport in Dar es Salaam City

Main problems of the transport system in DSM can be summarised;

- Serious road traffic congestion of trunk road in urban area during peak hours
- Low road network density as well as bus network especially in suburbs
- Frequent flooding of roads in urban areas in rainy season
- Mixture of cargo transport and passenger transport on some trunk roads to the port
- Poor transport management for efficient and safe traffic movement

To deal with the above problems in DSM where traffic demand would continuously increase in the future, not only supply-side measures but also demand-side ones should be implemented efficiently and effectively.

Firstly, from the wide view of traffic demand management to improve road congestion in the long run, at least a future urban structure plan including land use plan and urban development control, a road network plan, a public transport plan and a traffic management plan are necessary considerations and should be based on future transport demand. Especially since land use control is the key to manage traffic demand generation and distribution. Unfortunately, the Land Use Plan for DSM has not been updated since 1979. That would invite urban areas to expand in disorder. Such disorderly expansion with lower density of population would require endless investments in road infrastructure in an unsustainable or inefficient way. In order to tackle traffic congestion in cities with increasing population, urban areas must be organized well to harmonise with road infrastructure and public transport system through urban development control.

Secondly, in order to improve road congestion, public transport or mass transport system should be aggressively introduced to promote mass public transport use instead of micro/mini bus or motorcycle/private car use in the long term. Recently, transport in DSM has been changing in modal split since DART began to operate a new public transport system, BRT, on the 10th of May 2016. It seems that BRT is efficiently operated and effectively used by residents between CBD and suburbs. In addition, Commuter trains on the three routes operated by TRC and TAZARA have also been used efficiently despite the limited operations only during morning and evening peak hours. Both public transport systems can be said as very successful in that they provide more stable and more rapid mobility than bus, taxi, car and motorcycle. Number of users of both systems is assumed to gradually been increasing. This is attributed to not only their level of service but also heavily congested roads in the urban area of DSM. For example, if people use BRT between CBD and Ubungo, it takes approximately 30 minutes, while a car takes at least one hour in peak hours. Therefore, it is clearly recognised by the people that public transport like BRT or Commuter train is seen as indispensable systems and valuable modes to be enhanced more in DSM in the future. Therefore, the issues on this point are when, what and how public transport networks are strengthened from the view of catching up to the rapidly increasing transport demand.

Thirdly, road network should be improved with higher density suitable for urban traffic movement and bus service especially in suburbs. It seems that urban sprawl and housing development are scattered in the whole area of DSM without development control. There are increasingly poor urbanised areas especially along Nyerere Road and Kilwa Road. This issue should be tackled from the view of both of road provision by the road sectors and development control by the land use control

sector.

Fourthly, floods result to traffic accidents and congestion. Congestion, accidents and flooding can be seen as three major road problems in the urban area of DSM. And all three often happen at the same time at intersections. The issues should be dealt with as an urgent problem particularly in CBD.

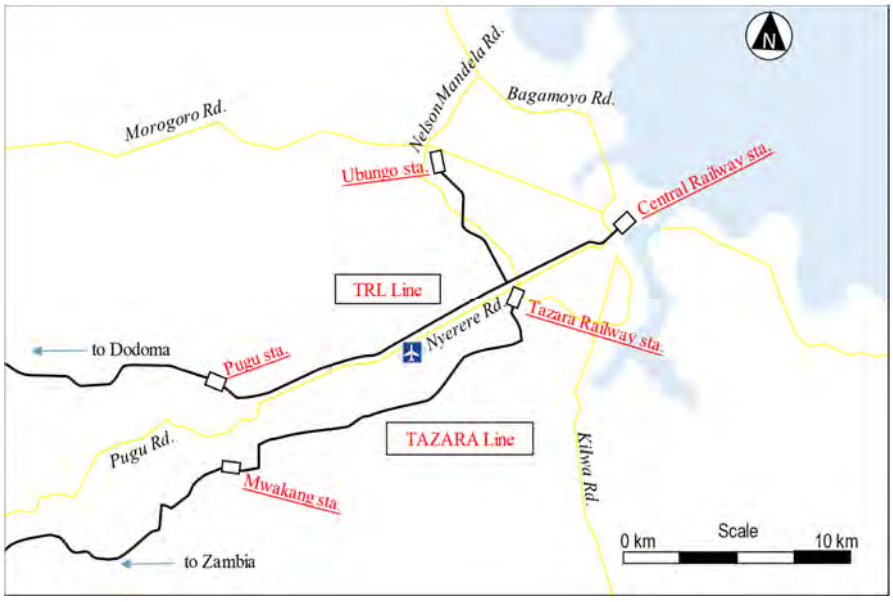
Fifthly, as one of the major ports in East Africa, DSM port would deal with more freight in the future for not only Tanzania economy but also neighbouring inland countries. Port towns like DSM are facing difficulty separating logistic transport with passenger transport on some trunk roads access to DSM port. This issue in DSM should be examined based on the analysis of a traffic survey and a new port development in Bagamoyo.

Finally, transport management schemes like parking restriction or signal control should be strategically implemented in a scientific way like using an Intelligent Transport System (ITS).

5.1.2 Public Transport

(1) Railway

TRC (Tanzania Railways Corporation) and TAZARA (Tanzania Zambia Railway Authority) are operating in DSM as shown on Figure 5.1.1. TRC main line section between Central Railway Station and Pugu Station is operating as a 20km long-commuter rail section. TRC branch line section between Central Railway Station and Ubungo Station, 11.7km long, is also operating commuter trains. TAZARA Railway is also operating commuter trains in an 18km section between TAZARA Railway Station and Mwakanga Station.



Source: JST

Figure 5.1.1 Existing Commuter Train Operation by TRC and TAZARA

1) TRC

a) Basic Information and Operating Condition

Basic information and operating condition are summarized in the Table 5.1.1 and Table 5.1.2 based on the hearing from TRC. The contents are described only for commuter trains in DSM in the table below.

Table 5.1.1 Basic Information of TRC Commuter Train Operation

Items	Contents
Operation Length	Main line: 20 km (Central Railway sta.～Pugu sta.) Branch line: 5.3 km (Central Railway sta.～Buguruni sta.)+ 6.4 km (Buguruni sta.～Ubungo sta.)
The number of tracks	Single
Electrification/Non-electrification	Non-electrification
The number of stations	Main line: 11 sta. Branch line: 8 sta.
Duration	Main line: 55 min. Branch line: 40 min.

Source: HP of TRC and hearing from TRC

Table 5.1.2 Operating Condition of TRC Commuter Train

Items	Contents
Train set	Main line：1 locomotive ＋ 20 coaches Branch line：1 locomotive ＋ 8 coaches
The number of rolling stock	Locomotives：3 Coaches：28
Capacity of the coach	150 persons（Seat: 80 persons, stand: 70 person）
Fare	Adult：600 TZS, Child：100 TZS Adult：400 TZS, Child：100 TZS
Fare collection method	At the station office, or in the train
Operation frequency	Main line：3 roundtrip in the morning, 3 roundtrips in the evening Branch line：3 roundtrip in the morning, 3 roundtrips in the evening
Duration	Main line：55 min. one-way Branch line：40 min. one-way

Source: Hearing from TRC

Timetables of the main line and branch line which are displayed at the Central Railway Station are summarized in Table 5.1.3 and Table 5.1.4. Three roundtrips are operated on both the morning and evening from DSM by one train set. Even though rehabilitation of the track and ballast supplement were done, train operation time has not been shortened due to the necessity of the rehabilitation of earthwork and rolling stock.

Scheduled speed of main line is calculated as 21.8km/h because trains are operated in 55 min. per one way in 20km. As same as main line, scheduled speed of branch line is calculated as 17.5km/h because trains are operated in 40 min. in 12km.

Table 5.1.3 Timetable of the Main Line of TRC

Morning

	Station	Departure time	Station	Arrival time
1	Dar es Salaam	4:45	Pugu	5:40
	Pugu	6:00	Dar es Salaam	6:55
2	Dar es Salaam	7:05	Pugu	8:00
	Pugu	8:10	Dar es Salaam	9:05
3	Dar es Salaam	9:15	Pugu	10:10
	Pugu	10:20	Dar es Salaam	11:15

Evening

	Station	Departure time	Station	Arrival time
1	Dar es Salaam	15:55	Pugu	16:50
	Pugu	17:00	Dar es Salaam	17:55
2	Dar es Salaam	18:05	Pugu	19:00
	Pugu	19:10	Dar es Salaam	20:05
3	Dar es Salaam	20:15	Pugu	21:20
	Pugu	21:20	Dar es Salaam	22:15

Source：Displayed at Central Railway Station

Table 5.1.4 Timetable of the Branch Line of TRC

Morning

	Station	Departure time	Station	Arrival time
1	Dar es Salaam	5:30	Ubungo	6:10
	Ubungo	6:30	Dar es Salaam	7:10
2	Dar es Salaam	7:30	Ubungo	8:10
	Ubungo	8:30	Dar es Salaam	9:10
3	Dar es Salaam	9:30	Ubungo	10:10
	Ubungo	10:30	Dar es Salaam	11:10

Evening

	Station	Departure time	Station	Arrival time
1	Dar es Salaam	16:00	Ubungo	16:40
	Ubungo	16:50	Dar es Salaam	17:30
2	Dar es Salaam	17:40	Ubungo	18:20
	Ubungo	18:30	Dar es Salaam	19:10
3	Dar es Salaam	19:20	Ubungo	20:00
	Ubungo	20:10	Dar es Salaam	20:50

Source: Displayed at Central Railway Station

b) Condition of Infrastructure

Based on the site visit made at Ubungo station, wear and irregularity of track are shown and ballast spreading is not enough at both stations as shown in Figure 5.1.2 as of the end of November 2016. On the other hand, it is considered to have operated without serious hindrance because of the six roundtrips every weekday. After the rehabilitation of main line between DSM and Pugu, serious rail irregularity was not found and ballast is enough supplied.

A platform at Pugu station does not exist, and passengers board and alight from both sides of the tracks freely. At the Ubungo station, a platform exists so passengers can board and alight the trains from it. Passengers seem to pass across the track because there is no level crossing around the station.

Pugu Station

Ubungo Station

Source: Taken by JST

Figure 5.1.2 Condition of the Rail Track at Pugu Station and Ubungo Station

c) Passenger Demand

According to the hearing from TRC, commuter trains of TRC transport approx. 25,000 passengers per day. In addition, it is possible to estimate the number of passengers based on the hearing information and current operation condition.

Prerequisites:

- Three round trips in the morning: occupancy ratio of up line is 100% and occupancy ratio of down line is 10%.
- Three round trips in the evening: occupancy ratio of down line is 100% and occupancy ratio of up line is 10%.

Based on the above prerequisites and operation condition (see Table 5.1.2), the total number of passengers are estimated at approx. 27,000 persons / day. Calculation process is shown in Table 5.1.5.

Table 5.1.5 Estimation of the Passengers Per Day in TRC

DSM～Pugu	No. of Coaches		Capacity		Occupancy ratio(%)		No. of operation		Transportation Capacity (person)
Up line in the morning	20	×	150	×	100	×	3	=	9,000
Down line in the morning	20	×	150	×	10	×	3	=	900
Up line in the evening	20	×	150	×	10	×	3	=	900
Down line in the evening	20	×	150	×	100	×	3	=	9,000
								Total	19,800
DSM～Ubungo	No. of Coaches		Capacity		Occupancy ratio(%)		No. of operation		Transportation Capacity (person)
Up line in the morning	8	×	150	×	100	×	3	=	3,600
Down line in the morning	8	×	150	×	10	×	3	=	360
Up line in the evening	8	×	150	×	10	×	3	=	360
Down line in the evening	8	×	150	×	100	×	3	=	3,600
								Total	7,920

Source: JST

2) TAZARA Railway

a) Basic Information and Operating Condition

Basic information of TAZARA railway is summarized in Table 5.1.6 according to the hearing from TAZARA Railway. This information covers only commuter trains in DSM.

Table 5.1.6 Basic Information of TAZARA Railway Commuter Train

Items	Contents
Operation Length	18 km（DSM～Mwakanga）
The number of tracks	Single
Electrification/Non-electrification	Non-electrification
The number of stations	12 stations
Duration	Approx. 50 min.

Source: HP of TAZARA Railway and Interview from TAZARA Railway

The operation condition of TAZARA Railway is summarized in Table 5.1.7. On-time operation is conducted and without serious delay.

Table 5.1.7 Operating Condition of TAZARA Railway Commuter Train

Items	Contents
Train set	1 locomotive ＋ 11 coaches
The number of rolling stock	Locmotive:1, Coaches:11 (Only 1 train set)
Capacity of the coach	Capacity:150 persons (Seats:80 persons, Stand:70 persons)
Fare	Adult：500 TZS, Child：100 TZS
Fare collection method	Pay in the train
Operation frequency	3 roundtrips in the morning, 3 roundtrips in the evening
Duration	Approx. 50 min. one-way

Source: TAZARA

Table 5.1.8 Timetable of TAZARA Railway Commuter Line

Morning

	Station	Departure time	Station	Arrival time
1	Dar es Salaam	4:45	Mwakanga	5:15
	Mwakanga	5:25	Dar es Salaam	6:20
2	Dar es Salaam	6:40	Mwakanga	7:30
	Mwakanga	7:40	Dar es Salaam	8:30
3	Dar es Salaam	8:45	Mwakanga	9:35
	Mwakanga	9:45	Dar es Salaam	10:35

Evening

	Station	Departure time	Station	Arrival time
1	Dar es Salaam	16:00	Mwakanga	16:50
	Mwakanga	17:00	Dar es Salaam	17:50
2	Dar es Salaam	18:05	Mwakanga	18:55
	Mwakanga	19:05	Dar es Salaam	19:55
3	Dar es Salaam	20:10	Mwakanga	21:00
	Mwakanga	21:10	Dar es Salaam	22:00

Source: Interview from TAZARA Railway

b) Condition of Infrastructure

According to the site survey of Mwakanga station, condition of the rail track and ballast spreading are comparatively good, thus it is considered to be operating without hindrance. Although a platform exists, it is inconvenient to board and alight due to the low platform.

Track condition at Mwakanga station

Low height platform at Mwakanga station

Source: Taken by JST

Figure 5.1.3 Condition of the Rail Track at Mwakanga Station

c) Passenger Demand

According to the HP of TAZARA Railway, commuter trains of TAZARA Railway cater to approx. 9,000 passengers per day. In addition, based on the estimation by the same prerequisite of TRC, daily passengers are calculated at approx. 10,000. These calculations and estimations are correlated respectively. The result of the assumption is shown in Table 5.1.9.

Table 5.1.9 Estimation of the Daily Passenger of TAZARA Railway

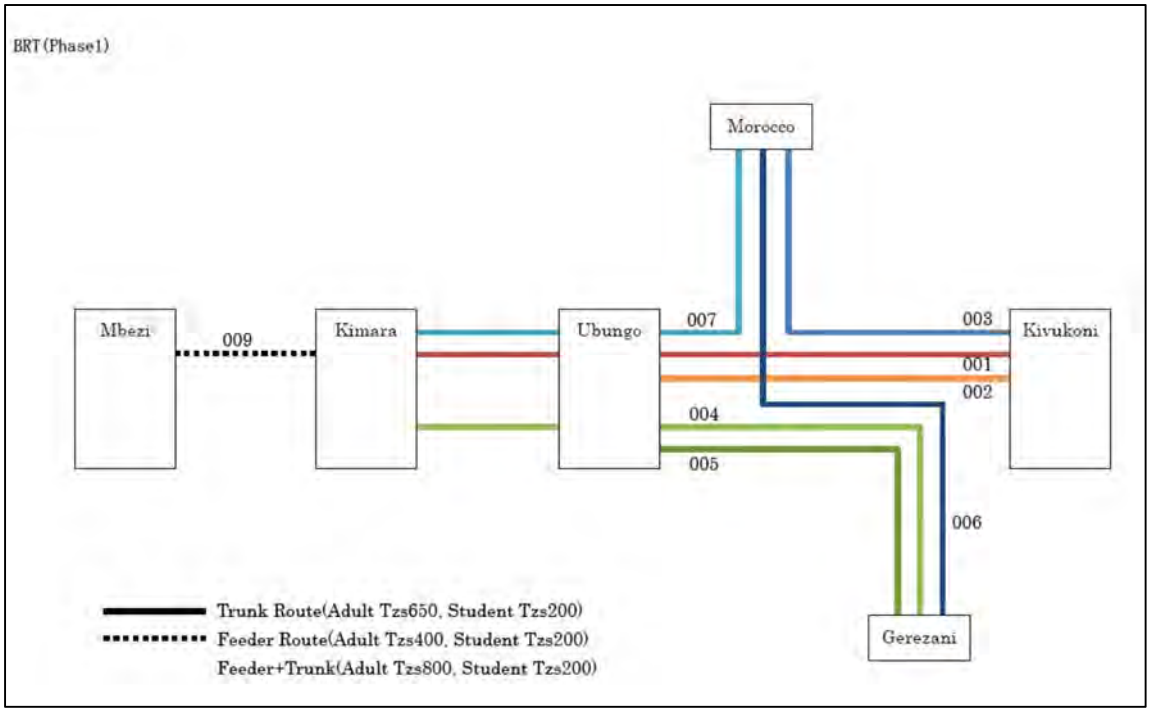
DSM～Mwakanga	No. of Coaches		Capacity		Occupancy ratio(%)		No. of operation		Transportation Capacity (person)
Up line in the morning	11	×	150	×	100	×	3	=	4,950
Down line in the morning	11	×	150	×	10	×	3	=	495
Up line in the evening	11	×	150	×	10	×	3	=	495
Down line in the evening	11	×	150	×	100	×	3	=	4,950
								Total	10,890

Source: JST

(2) BRT

1) Outline

Figure 5.1.4 shows the schematic BRT Phase-1 Route map. Operation was launched on 10th of May 2016. Colour solid lines are Trunk Route (001-007) and dotted line is Feeder Route (009).



Source: prepared by JST

Figure 5.1.4 Schematic Diagram of BRT Phase-1 Route

a) Phase 1 Component

- Road : 20.9km
- Bus Station : 27
- Bus Terminal : 5
- Pedestrian Bridge : 3 (Morocco, Ubungo, Kimara)
- Bus Depot :1 (Jangwani)
- Project Cost : 322 billion TZS

b) Fare (2017 Dec.)

Trunk Route	Adult: 650 TZS	Student: 200 TZS
Feeder Route	Adult: 400 TZS	Student: 200 TZS
Trunk and Feeder Route	Adult: 800 TZS	Student: 200 TZS

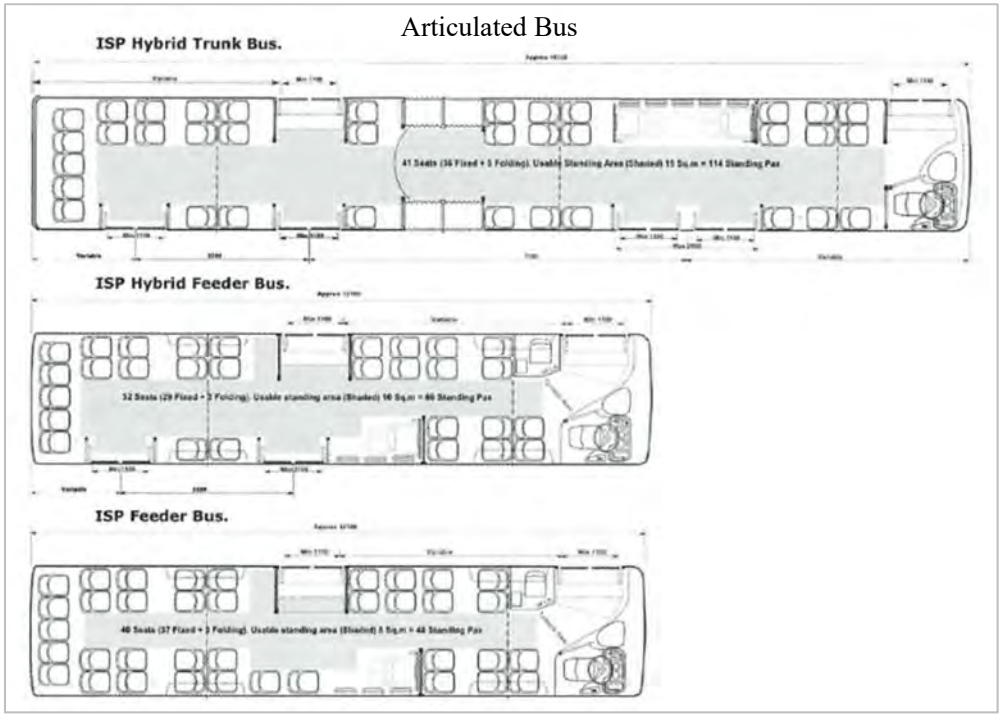
Note: see Figure 5.1.1-4.

c) Operating Bus

There are three types of BRT buses shown in Figure 5.1.5. The number of buses is currently 140. Each bus is allocated to each route as shown in Table 5.1.10.

Articulated Bus	39
Hybrid Feeder Bus	76
Standard Bus	25
Total	140

Note: Hybrid feeder buses are able to operate on both trunk roads and feeder roads.



Source: DART

Figure 5.1.5 BRT Bus Type

Table 5.1.10 Number of Operating BRT Bus for Each Route

Number of Routes	Place/Route	Number of buses operating
001	Kimara- Kivukoni	30
002	Ubungo- Kivukoni	13
003	Morocco- Kivukoni	10
004	Kimara- Gerezani	27
005	Ubungo – Gerezani	11
006	Morocco- Gerezani	8
007	Kimara- Morocco	8
009	Kimara- Mbezi	8

Note: See Figure 5.1.4 , each Number of Routes

Source: DART

d) Bus Capacity

Articulated Bus	140 passengers
Standard Bus	80 passengers

e) Operation Time

5 a.m. to 12:00 a.m. (midnight)

Shown in Table 5.1.11, BRT bus operates full (=100%) during peak hour (6:00-10:00 and 16:00-21:00) on weekdays.

Table 5.1.11 BRT Master Time Table

Weekdays: Monday to Friday						
Period	5:00-6:00	6:00-10:00	10:00-16:00	16:00-21:00	21:00-22:00	22:00-24:00
Operation Rate	30%	100%	75%	100%	60%	25%
Saturday						
Period	5:00-6:00	6:00-10:00	10:00-19:00	19:00-21:00	21:00-24:00	
Operation Rate	30%	100%	75%	50%	25%	
Sunday and Public Holiday						
Period	5:00-6:00	6:00-21:00	21:00-24:00			
Operation Rate	30%	55%	30%			

Source: DART

f) Operation Frequency

Initial stage was operated at a 5-minute interval, but due to high demand and lack of capacity, the operation frequency was currently changed to 3-minute interval.

g) Daily Passenger

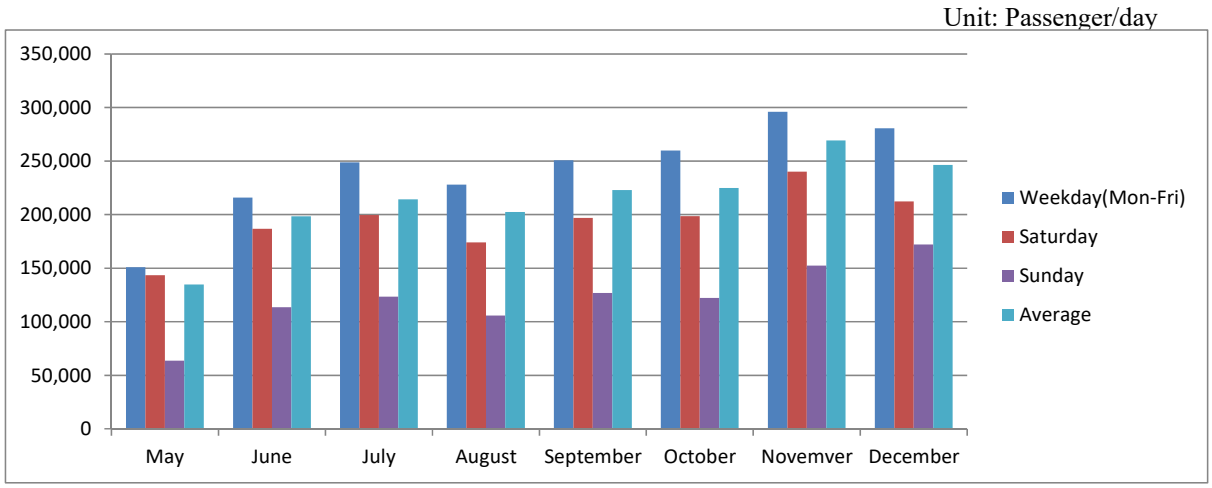
Table 5.1.12 and Figure 5.1.6 shows the trend of the number of BRT daily passengers. Though the average number of passengers at opening months (2016 May) was only 134,695, it increased day by day, and the number of passengers on November 2016 reached 269,000. The number of passengers on weekdays is the highest. The number of passengers on Saturday was 80% that of the weekdays' and on Sunday was 50% of weekdays'.

Table 5.1.12 Number of Daily BRT Passenger (2016 May to December)

Unit: Passenger/day

	May	June	July	August	September	October	November	December
Mon-Fri	151,016	215,927	248,811	227,897	250,593	259,894	295,898	280,529
Saturday	143,440	186,816	199,551	174,052	196,894	198,713	239,976	212,297
Sunday	63,579	113,496	123,337	105,783	126,835	122,244	152,319	172,120
Average	134,695	198,388	214,141	202,452	222,972	224,819	269,298	246,284

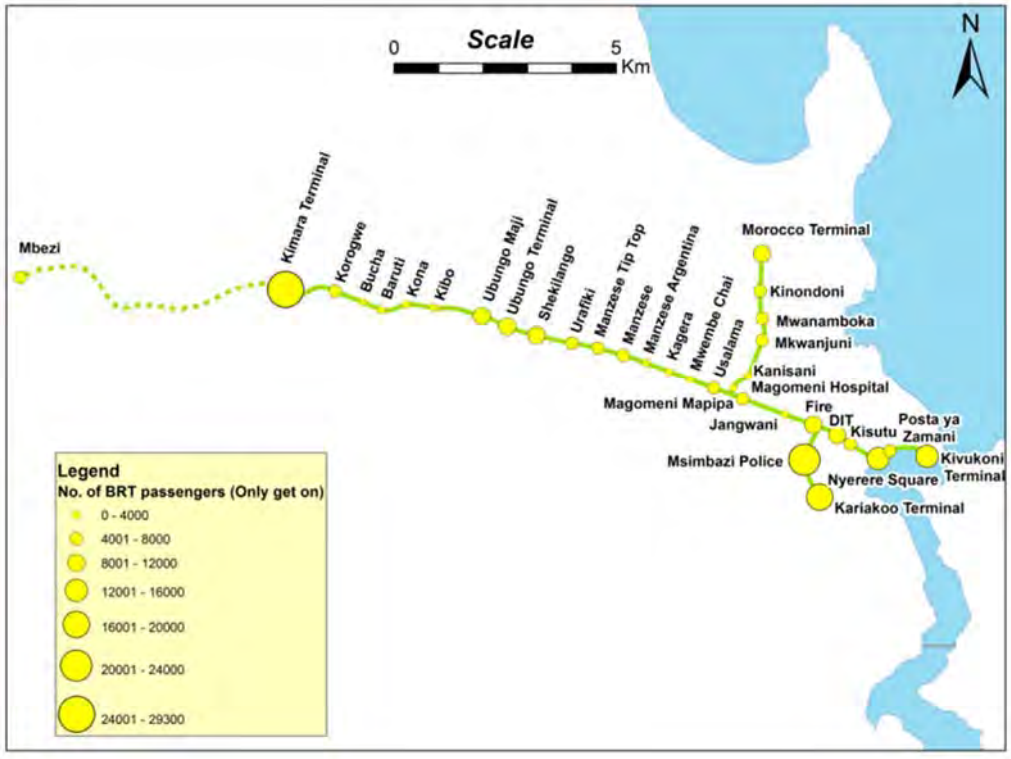
Source: UDART



Source: UDART

Figure 5.1.6Number of Daily BRT Passenger (2016 May to December)

Table 5.1.13 and Figure 5.1.7 shows the number of BRT passengers at stations (only get-on passengers). The busiest station is Kimara Terminal, at 29,255 passengers per day. The second and third busiest stations are Msimbazi Police and Gerezani/Kariakoo Terminal. The fourth and fifth busiest stations are City Council and Kivukoni Terminal located in CBD. Based on these figures, major trips are expected from to Kimara Terminal and Kariakoo Area or CBD.



Source: UDART

Figure 5.1.7 Number of Daily BRT Passenger at Station (2016)

Table 5.1.13 Number of BRT Passenger at Station

Station	No. of BRT Passengers (Only get on).
Kimara Terminal	29,255
Korogwe	7,820
Bucha	2,809
Kona	3,854
Kibo	3,740
Ubungo Maji	10,670
Ubungo Terminal	11,611
Shekilango	8,539
Urafiki	4,285
Tip Top	5,414
Manzese	7,010
Argentina	1,502
Kagera	3,650
Mwembechai	1,621
Usalama	4,518
Magomeni Mapipa	5,684
Jangwani	351
Fire	11,164
DIT	8,310
Kisutu	4,147
Halmashauri ya Jiji	13,861
Posta ya Zamani	7,878
Kivukoni Terminal	14,595
Magomeni Hospital	1,454
Morocco Hotel	2,610
Mkwajuni	4,510
Mwanamboka	6,178
Kinondoni	5,933
Morocco Terminal	10,664
Msimbazi Police	20,770
Gerezani Terminal	19,897
Other Bus Stop	10,252
Mbezi Luis	5,865
Total	**260,421**

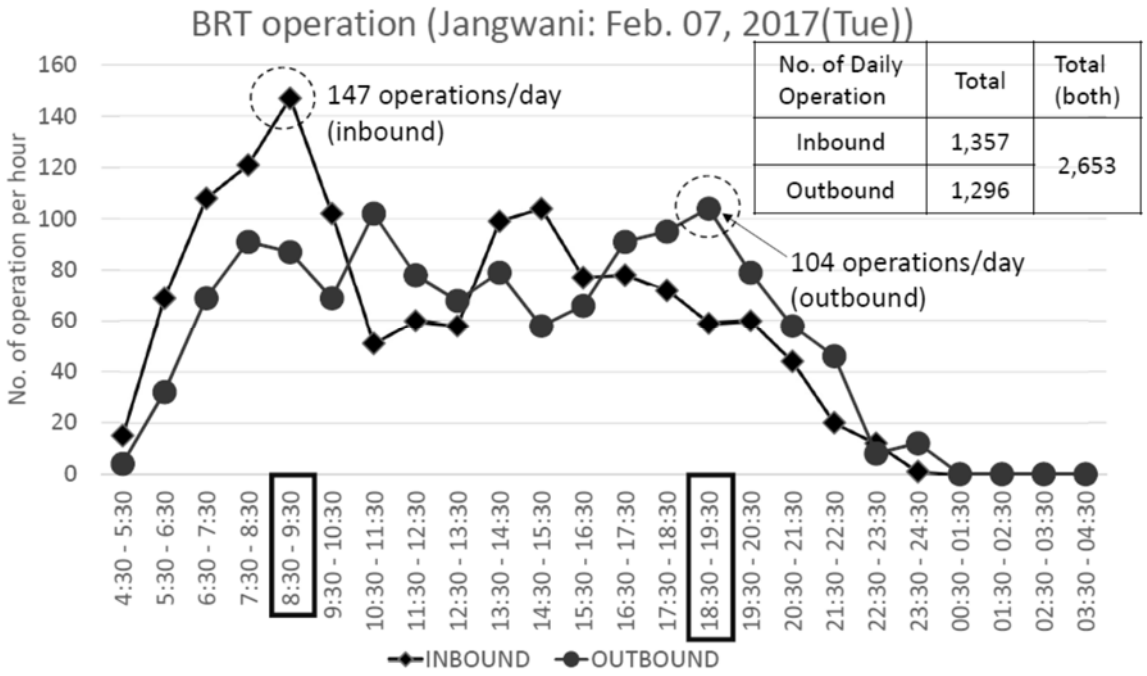
Note: Average daily passengers on Weekday from May to Dec. ,2016

Source: UDART

h) BRT Section Volume and PHPDT

BRT traffic count was conducted at Jangwani section as shown in Figure 5.1.8. Daily BRT volume was 2,653 and the inbound peak BRT volume was 147 BRT/hour (morning 7:30-8:30) and outbound peak BRT volume was 104 BRT/hour (evening 18:30-19:30).

During peak hours, assumed average capacity of BRT buses (Articulated Bus 140, Standard Bus 80) is 100, Peak Hour Peak Direction Traffic (PHPDT) is approximately 14,700 (=147*100).



Source: JST

Figure 5.1.8 Number of BRT Volume at Jangwani Section (2017 Feb.)

2) Intelligent Transport System (ITS) and Payment System

Regarding ITS, currently, there are neither CCTV cameras nor a control centre yet but arrangements are being made to have them. DART has two different control centres; one for regulation and the other for operation. DART have plans to construct a control centre at Kariakoo terminal.

Regarding the payment system, there are two systems available: prepaid card which one can top up by using their phone or at the bus stations, and the other system is the use of a paper ticket.

3) PPP Scheme

For smooth operation, the government decided to commence the Interim Service Provider (ISP) to be operated on the BRT section. The ISP was commissioned to UDART. UDART is a special purpose company formed by UDA Company, the two Daladala Associations and other UDART owners who exerted into agreement for operating the interim services on February 13, 2015. This was done because the procurement process to get a Service Provider through PPP approach would take a long time while at the same time the completed infrastructure would remain idle and prone to vandalism and misuse. This agreement is to be for two years, anticipating that a Service Provider will be procured through a competitive process.

Based on the DART investment plan for the year 2016/2017, preparations to procure Service Provider (SP) through international tender invitations, valuation of bids and contact documentation for SP competitive bidding process.

4) Issues

- Traffic road crash, especially involving pedestrians, cars and buses at mixed lanes
- Low capacity at Kimara Station (under traffic estimation)

- Due to overloading, time schedule is not being followed properly.
- Human intervention especially by the traffic police who sometimes are manually controlling the traffic is a hindrance.
- Due to limited space along Kisutu-Nyerere Square section, there are no overtaking lanes, meaning BRT on that section would have to wait a little longer.

5) Improvement Plan

- To improve the time schedule to accommodate the traffic demand,
- To increase the number of buses which are supposed to start at certain terminals especially at Kimara terminal where there are a large number of passengers,
- To increase the number of buses that is for tender is being advertised, and to add another operator.

 Ticket Gate	 BRT lane
 BRT Station	 Pedestrian crossing at station
 BRT Station with overtaking lane	 Buses could stop at the same time
 BRT Lane inside CBD	 BRT Lane inside CBD
 Priority Seat	

Figure 5.1.9 Current BRT Operation (Photo)

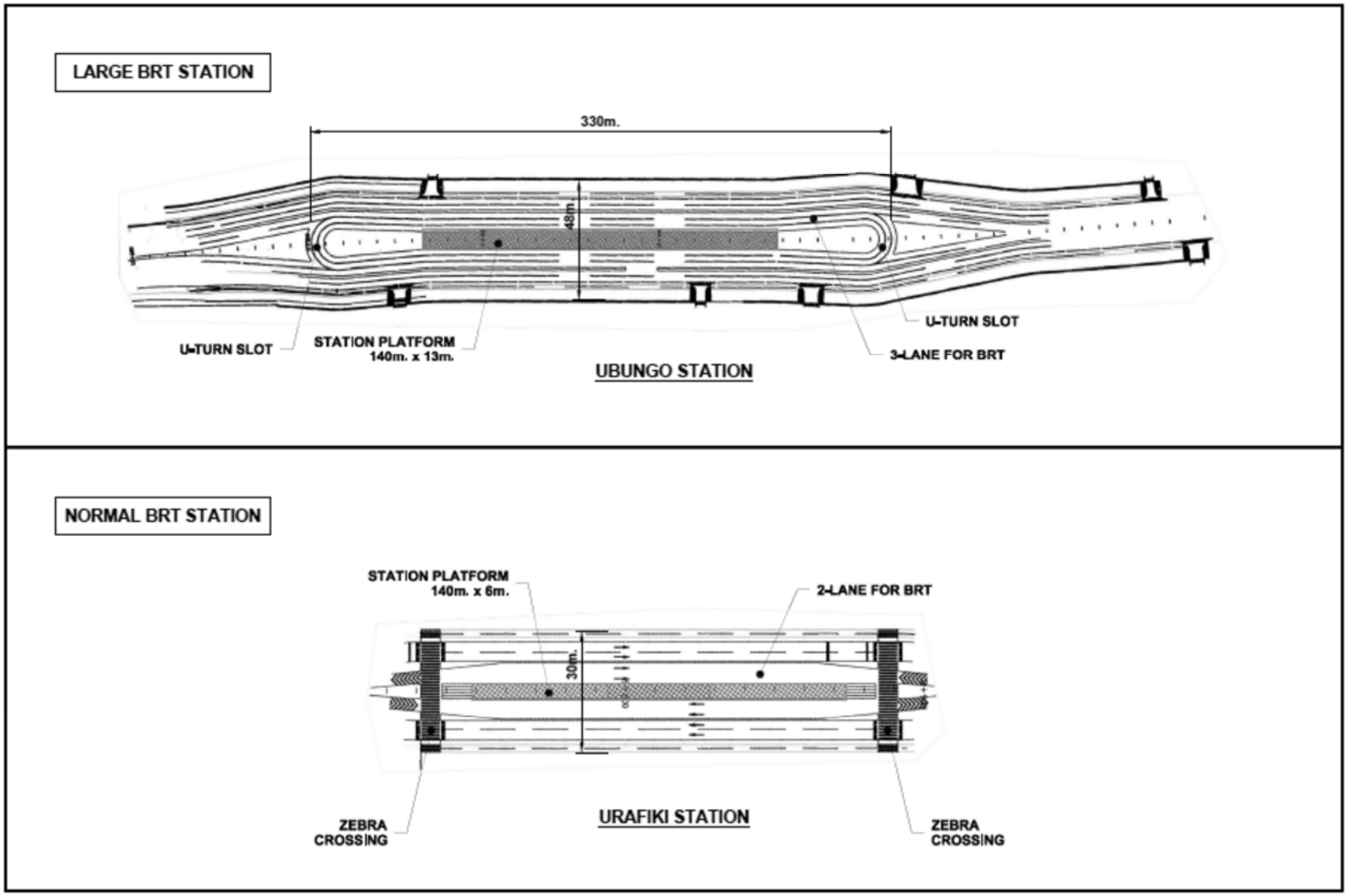


Figure 5.1.10 BRT Station Layout

(3) Bus Terminal

There are three types of bus terminals in DSM.

Table 5.1.14 Type of Bus Terminals in DSM

Bus Terminal	No. of Terminal	Responsible Agency
Inter-city Bus Terminal	1 (Ubungo)	DCC
BRT Bus Terminal	5 (Ubungo, Kimara, Kivukoni, Morocco, Kariakoo)	DART
City Bus Terminal	13(see Figure 5.1.11) Inside CBD (4): Posta, Mnazi Mmoja, Muhimbili, Stesheni along Bagamoyo Road (3): Makumbusho, Mwenge, Tegeta along Morogoro Road (2): Simu2000, Mbezi along Nyerere Road (2): Buguruni, Gongo la Mboto along Kilwa Road (2): Temeke, Mbagala	Each Municipal Council

Source: JST

1) Ubungo Bus Terminal

The Inter-City Bus Terminal is located at Ubungo. Fifty-two percent of the Ubungo bus terminal area is for BRT operated by DART; and the remaining area is for inter-city bus operated by DCC. DCC is collecting fees from inter-city bus companies. As Ubungo bus terminal area will not be able to expand, DCC has planned for new inter-city bus terminals. (see Chapter 3.2.3(4))

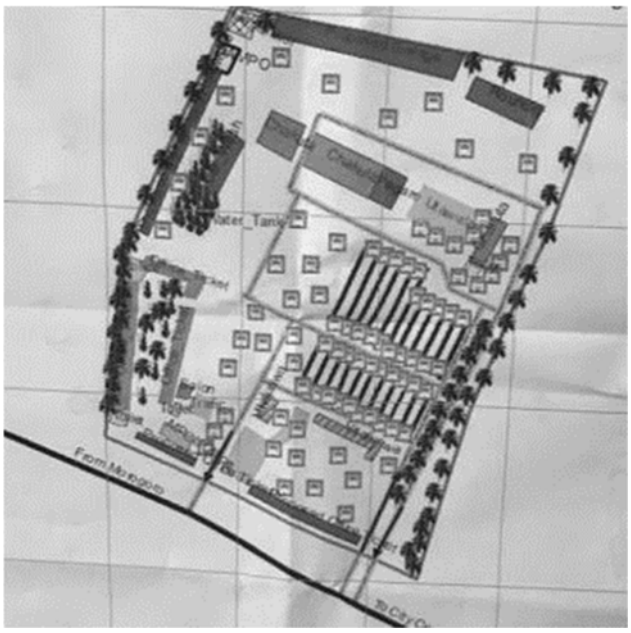


Figure 5.1.11 Ubungo Bus Terminal Layout

2) Bus Terminal beside BRT Station

BRT Bus terminals are located along the start and end stations for trunk roads. The Terminals allow transfers between feeder services as well as providing access to various transportation services such as Daladala, Bajaj and private vehicles (see Table 5.1.15 and Figure 5.1.12). Kimara Terminals also contain parking lots to allow commuters to leave their cars during the day.

Table 5.1.15 Daladala Terminal at BRT Station

Kivukoni Terminal	 Start Station of BRT phase-1. It is designed well considering bus birth and stops each destination and parking space for par transit.
Kimara Terminal	 Park & Bus ride was installed at Kimara Terminal. Currently there are 100 parking car spaces at Kimara terminal then people transfer to BRT going to CBD area. DART plans to install additional 5,000 parking spaces, for Park & BRT ride along Morogoro road.
Morocco Terminal	  Beside the BRT station, Morocco Terminal was built for Daladala.There is no parking or stooped space for Bajaj and Bodaboda, they park on the sidewalk space. (see right photo)
Kariakoo Terminal	  At the same as the construction BRT phase-1, the new Daladala terminal was constructed. Kariakoo terminal will not only be for phase-1, but also for phase-2 and phase-3. As of now, Kariakoo terminal is only for Daladala. Though there were benches and roofs installed, there is no Daladala information and guidance such as destination, time table, etc.

Source: JST

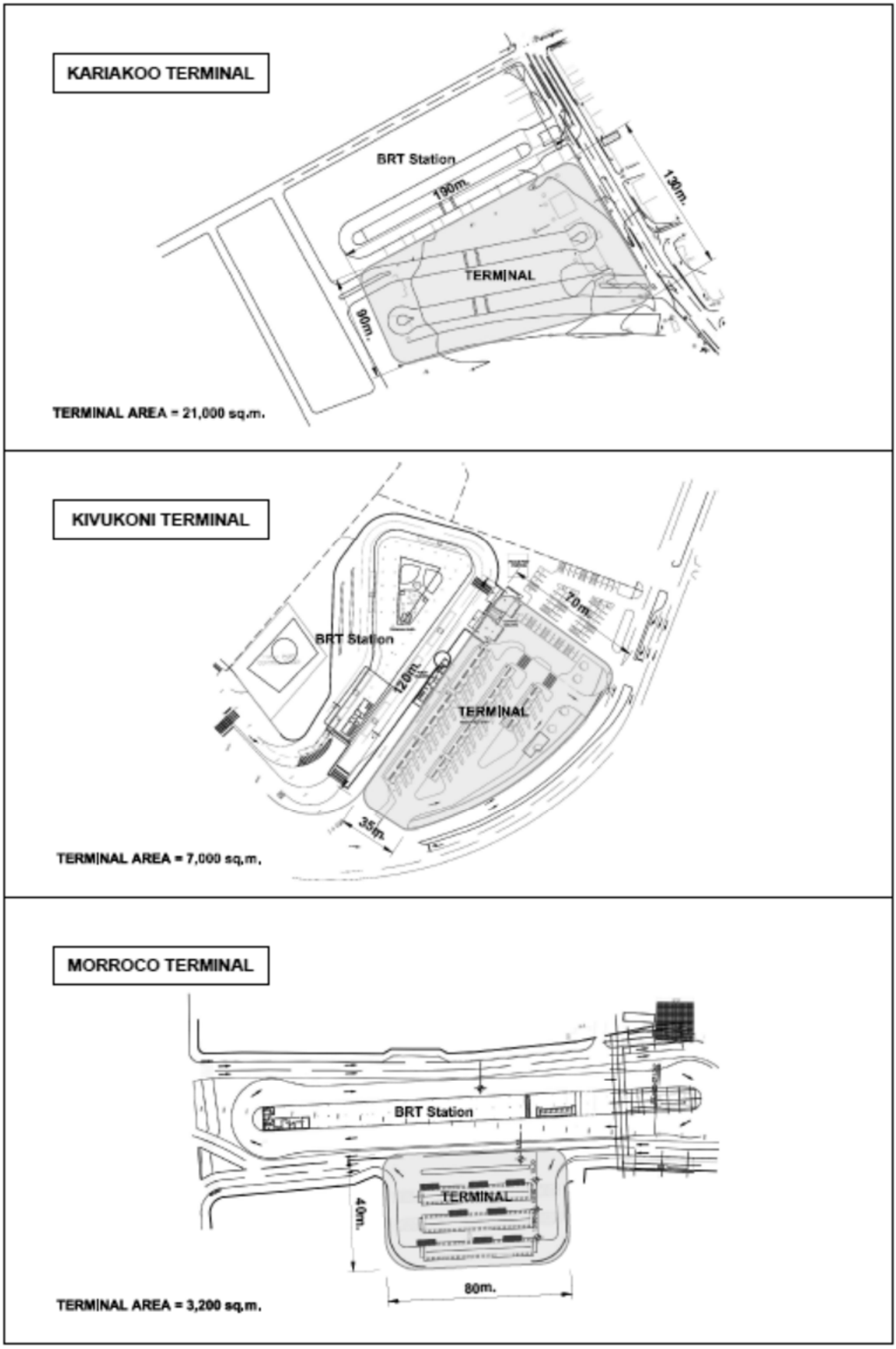


Figure 5.1.12 Daladala Terminal at BRT Station

3) Other Terminals

Table 5.1.16 City Bus Terminal for Daladala

Makumbusho: access road of bus terminal was unpaved and bad road condition. Currently all the access roads are paved.


Simu2000 is designed well considering bus birth and stops at each destination and connection with para transit such as taxi, Bajaj and private car.


Station Bus Terminal is seen to have many passengers who are waiting for buses and all buses are fully-loaded in the evening peak hours.

Posta terminal is on-road.

Temeke Terminal: Small terminal. There are inter-city buses, Daladala and Bajaj.

Mbagala Terminal: unpaved terminal. There is no designed as terminal. It just has big spaces for Daladala ride-on/off. No bus berth, no roof and no benches. Many passengers stand when waiting for the Daladala.

Tegeta Terminal: unpaved terminal. There is no designed as terminal.

(4) Bus except BRT and Other Public Transport

1) Types of Buses and Other Public Transport

- The operators of buses and other public transport need to apply for applicable licence to SUMATRA.
- There are several types of licenses, categorized below.

Table 5.1.17 Types of Bus and Other Public Transport

Type			Sitting Capacity	Fare
Long Distance Bus	Large Bus		46-65	Paved Roads Ordinary 36.89 TZS/Km Semi Luxury 53.22 TZS/Km Luxury 58.47 TZS/Km Unpaved Roads Ordinary 46.11 TZS/Km
Commuter Bus (Daladala)	Medium Bus		26-45	Adult 0-10 Km: TZS 400 11-15 Km: TZS 450 16-20 Km: TZS 500 21-25 Km: TZS 600 26-30 Km: TZS 750 Student Flat rate TZS 200
	Mini Bus		16-25	
	Micro Bus		7-15	
Taxi			4	Fare will be determined by negotiation with drivers
Tricycle Taxi (Bajaj)			3	Fare will be determined by negotiation with drivers
Motorcycle Taxi (Bodaboda)			1	Fare will be determined by negotiation with drivers

Source: Interview to SUMATRA by JST, Nov 2016, *SUMATRA press release Nauli 2013*

2) Procedure to get Bus License

- The required paperwork to get any kind of license is the same.
- To apply for a license for long-distance buses including international operated bus, the applicant must have four or more buses. The reason for this requirement is that the operator will be able to change the bus immediately to keep the operation in case of an accident or malfunction.
- The bus operator which starts to operate bus service has to submit the paperwork including the following:
- SUMATRA will issue a license to the applicant after all application processes are completed. The period of the licence is one year.

1. Fully completed application form
2. Vehicle registration card
3. Certificate of insurance
4. Certificate of vehicle inspection from police
5. Receipt of payment for the certificate of vehicle inspection from the police
6. Driver's license
7. Photo of the driver (passport size)
8. Driver employment agreement ratified by the ministry of labour
9. Renewal license
10. Time table
11. Sample of ticket
12. Sample of passenger's book
13. Company registration certificate
14. TIN certificate (Taxpayer Identification Number)
15. Tour license
16. Contract between the owner of the bus and the company or the school

Source: Interview to SUMATRA by JST, Nov 2016

3) Current Operation of Long Distance Bus

- The long-distance buses are operated among DSM and major cities.
- Over 100 bus routes are listed on the fare table as listed in Annex.

4) Present Operation of Commuter Bus

- There are major bus terminals in CBD and along the four radial trunk roads. The commuter buses operate between those terminals.
- According to the fare table which was revised on the 12th of April 2013, there are 263 bus routes.
- According to regulation, the allowed operating hours is from 5:00 to 23:00 and the operation is prohibited late at night. However, some bus operators are in 24-hour operation. Currently, there are no penalties for operators who violate the regulation.
- The average working hours per bus is 12 hours or eight round trips.
- The bus routes are mainly concentrated along the trunk roads. In addition, many of these routes take similar directions, as shown in the figure below.

Source: Report on Consultations with existing DALADALA operators and the mitigation measures by DART

Figure 5.1.13 Commuter Bus Routes before BRT (phase-1) Starts

SUMATRA issues an annual license to each bus to ply on a particular route. There are 4,955 operators who hold licenses, and the number of their registered buses is 7,670. The average number of buses held per operator is 1.5 buses, which is very low. There is no transport schedule for the whole bus transportation service. Also, none of the schedules are controlled by any organisation.

Table 5.1.18 Average Number of Buses Held per Operator

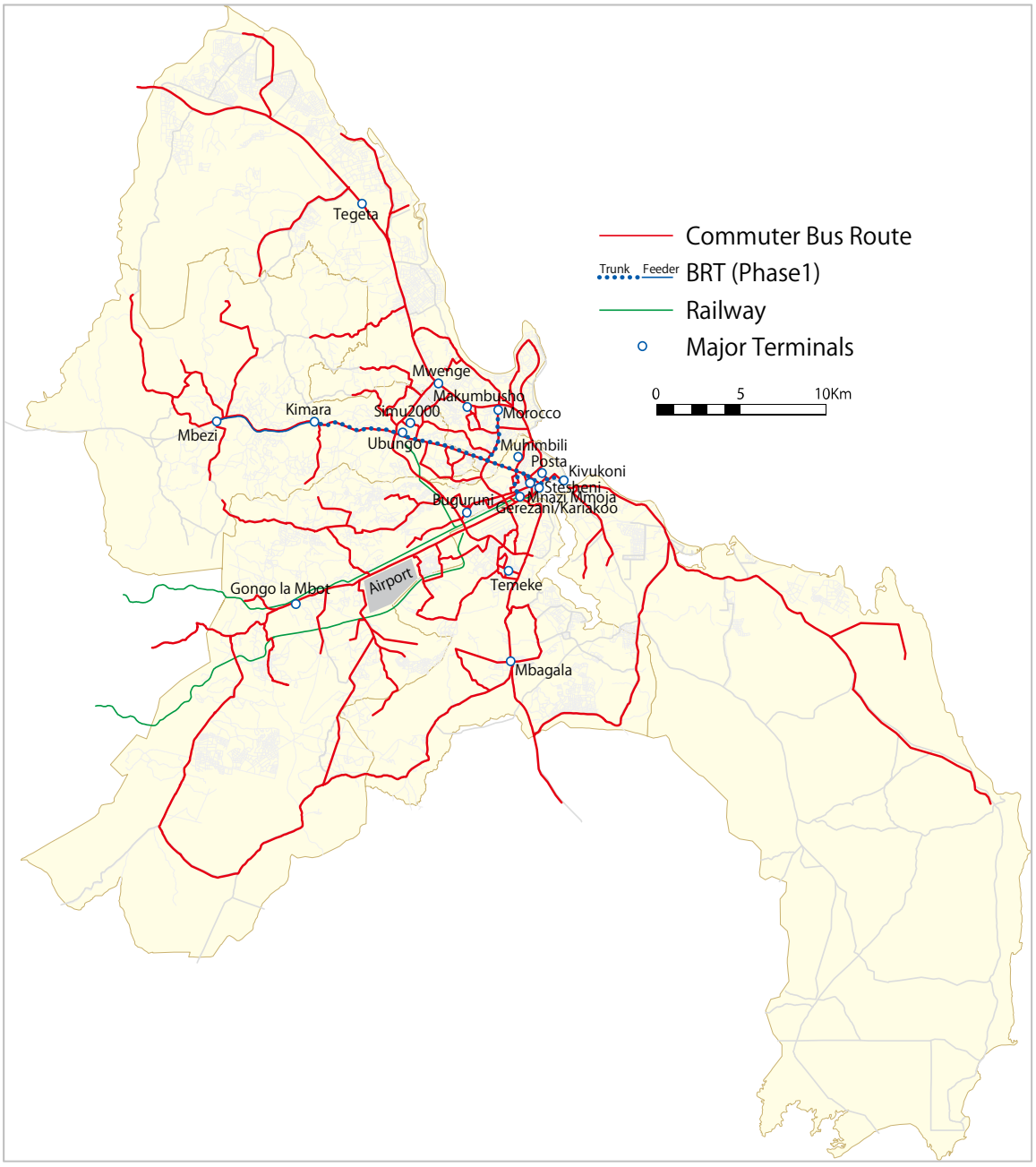
Number of Licensed Companies in DSM	4,955
Number of Buses in DSM	7,670
The average number of buses held per operator	1.5

Source: Interview to SUMATRA by JST, Nov 2016

The following pictures show the common bus stop. They have rooftops or benches.

Source: JST

Figure 5.1.14 Common Bus Stops in the City



Source: Digital Data for Transport in DSM: by WORLD BANK GROUP

Figure 5.1.15 Commuter Bus Route and Major Terminals

5) Present Issues of Commuter Bus

Inefficient operation

There are various bus routes among various terminals with various directions. The current bus transportation is not managed efficiently as a lot of these bus routes are duplicated. Thus, this causes traffic jams and it is hard for people to understand the bus transportation system.

Crowded buses

The supply is always less than the demand because the size of the vehicle is small. As a result, all buses are totally packed. Some passengers are not able to get on the bus at bus stops.


Source: JST

Figure 5.1.16 Crowded Bus Terminal in Rush Hour

Lack of information about bus services

Origin, destination and fares are clearly marked on each bus. Only people who use the bus route constantly can understand the operating information as the information is only showed on the body of the bus. The general information about bus service including route maps, bus stops, frequency, operating time, fares are not available.

The origin/via/destination that was shown on the front body

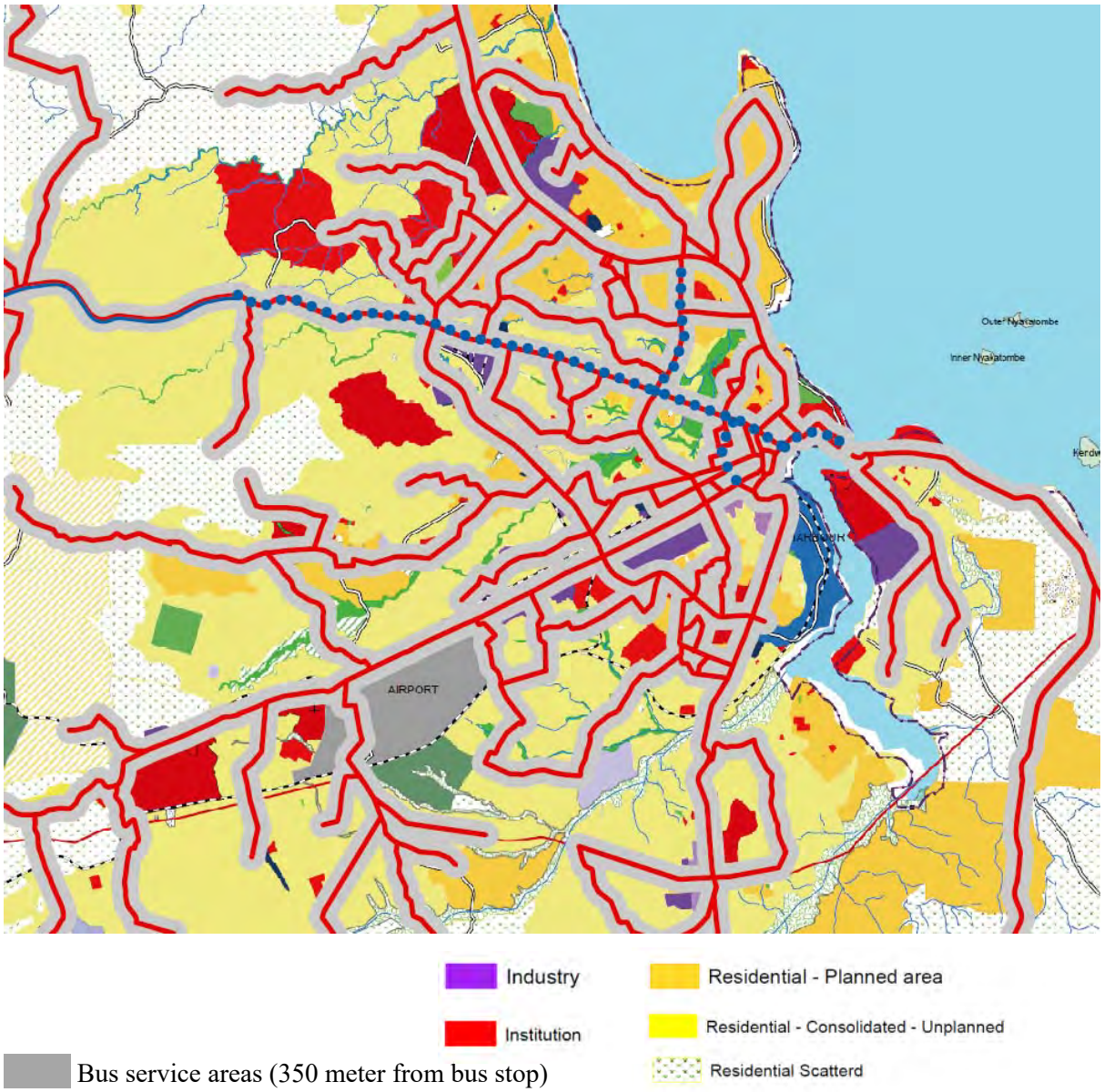
The fare that was shown on the side body

Source: JST

Figure 5.1.17 Bus Information only on the Body

Areas not provided with the bus services

There are many residential areas that have not been provided any bus services as the roads in those areas are too narrow for a bus.



Determined the bus service area for each bus stop as 350m which is half of the average distance between BRT stations (Kivukoni～Kimara 15.6km / 23 between stations = 678m = approximately 700m)

Source: JST

Figure 5.1.18 Bus Service Areas and Current Land Use

(5) Summary of Present Public Transport Service

Since BRT's operation in the DSM was started, the public transport users realized that BRT is very convenient; hence a good public transport system. The keywords such as mobility, comfortability, accessibility, convenience, affordability and safety in public transport system were summarized below.

1) Mobility (see Table 5.1.19)

Average travel speed of BRT and Railway is not bad, at more than 20km/h. However, the speed of Daladala depends on the road traffic congestion (10-18km/h).

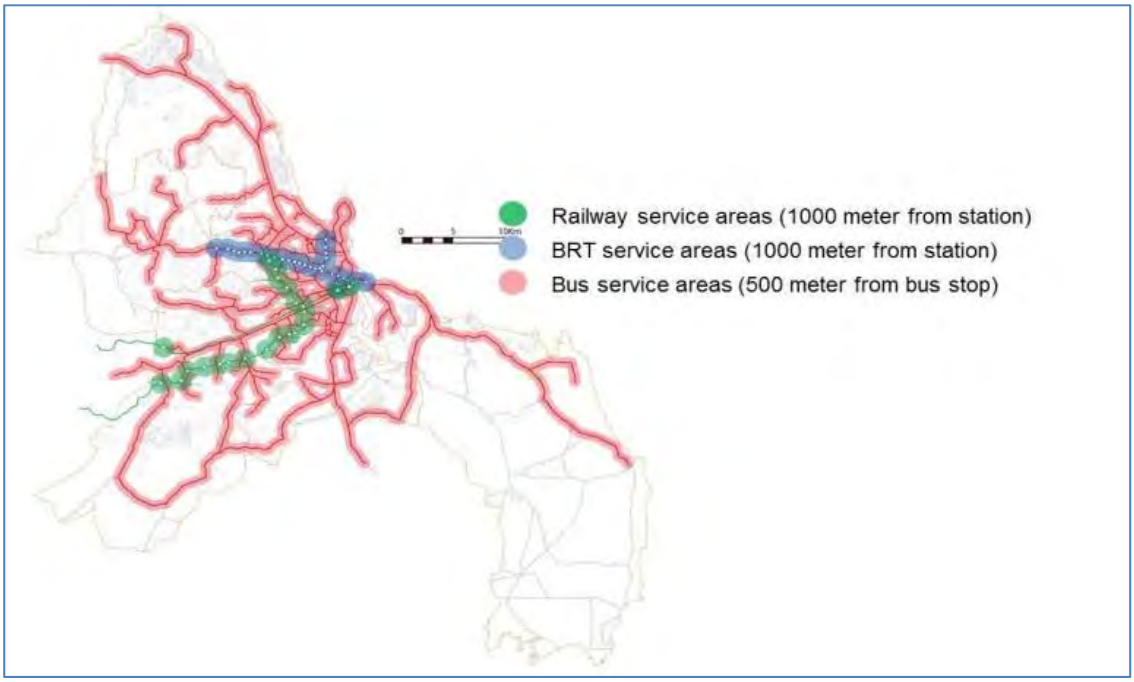
Table 5.1.19 Travel Speed and Time of Present Public Transport

	TRC-Railway	TAZARA- Railway	BRT Phase-1	Daladala
Distance	Main 20km Branch 11.7km	18km	20.9km	Morogoro Road between Mbezi and Posta
Travel time (approximate)	Main 55min. Branch 40min.	50min.	50min.	60-192min.
Ave. Travel Speed	Main 22km/h Branch 18km/h	22km/h	21km/h (Local) 23km/h (Express)	10-18km/h

Source: TRC, TAZARA Railway, DART and SUMATRA

2) Accessibility (Public Transport Service Area)

Though public transport service is generally covered in the central area (within Nelson Mandela Rd.), public transport service is not fully covered in the suburb areas shown in Figure 5.1.19. Thus, it is not convenient for the users.



Source: JST

Figure 5.1.19 Public Transport Service Coverage Area in DSM

3) Punctuality /Convenience

All public transport modes operate from early morning to late at night as shown in Table 5.1.20. Currently, railway operations are three (3) round trips in the morning and evening peak hours only.

Table 5.1.20 Operation Route, Operation Hour and Frequency of Each Public Transport Mode

	TRC-Railway	TAZARA- Railway	BRT Phase-1	Daladala
Route	Main line (Pugu Sta. - Central Sta.) Branch line (Ubungo Sta. - Central Sta.)	Mwakanga Sta. – DSM	Kimara – Kivukoni 20.9km	-
Operation Hour	Main: From 4:45 to 21:20 Branch line: From 5:30 to 20:50	From 4:45 to 22:00	From 5:00 to 24:00	Allowed operating hours from 5:00 to 23:00
Frequency	Three (3) roundtrips in the morning and evening each		Opening stage: five-minute interval. Due to lack of passenger capacity, current frequency during peak hour is three (s) minutes.	Averaging working hours per bus is 12 hours or eight (8) roundtrips

Source: TRC, TAZARA Railway, DART and SUMATRA

4) Comfortability

As BRT bus and Daladala are very crowded, many passengers do not feel comfortable.

Inside BRT Bus

Daladala

Source: JST

5) Affordability

Public Transport fare in DSM is 400–800 TZS. It is much more affordable than a private car's transport cost (4,250 TZS).

Private car's transport cost (only gas) is 4,250 TZS (=1700*20 /8)

Assumptions: 20[km]distance, gas fee: 1700[TZS/litter], average fuel consumption 8[km/litter]

Table 5.1.21 Present Public Transport Fare

	TRC-Railway	TAZARA- Railway	BRT Phse-1	Daladala
Adult	Main 600TZS Branch 400TZS (Main 20km, Branch 11.7km)	500TZS (18km)	Trunk 650TZS Feeder 400TZS Trunk+Feeder 800TZS (20.9km)	0-10km 400TZS 11-15km 450TZS 16-20km 500TZS 21-25km 600TZS 26-30km 750TZS
Student	Main 100TZS Branch 100TZS	100TZS	200TZS	200TZS

Source: TRC, TAZARA Railway, DART and SUMATRA

6) Safety

Due to bad driving manners of some Daladala drivers, Daladala has had many traffic accidents according to DART.

Regarding BRT, traffic accidents occur at BRT mix lane with motorcycles and pedestrians at pedestrian crossings.

During heavy rain, floods disturb not only road traffic, but also public transport. As the BRT route passes at Jangwani, which is a low=land area, the Jangwani section closes during heavy rainfall. Public Transport System should be considered as tough transport system.

5.1.3 Road

(1) Regulation and Guidelines on Road Plan and Management

1) Guidelines and Standards

- In road sector, there are related regulations and standards for road plan, design, traffic control and operation as following;
- Pavement and Materials Design Manual, (1999) by Ministry of Works
- Laboratory Testing Manual (2000) by Ministry of Works
- Standard Specifications for Road Works (2000) by Ministry of Works
- Field Testing Manual (2003) by TANROADS
- Road Maintenance Manual (2009) by TANROADS
- A Guide to Traffic Signing (2009) by Ministry of Infrastructure Development
- A Guide to Road Safety Auditing (2009) by Ministry of Infrastructure Development
- The SATCC* Road Traffic Signs Manual (3rd Edition)
- Road Geometric Design Manual (2011 Edition) by Ministry of Works* Southern Africa Transport and Communications Commission

Important factors for road planning such as road classification, access control, cross section dimension and Level of Service (LOS) are noted in the 'Road Geometric Design Manual' in Tanzania.

2) Road Classification

a) Administrative and Functional Classification

In Mainland Tanzania, the existing classification is partly based on administrative aspects of the facility and partly on functional aspects. The existing network is classified in accordance with the Road Act of 2007. Administrative and functional classification of roads is summarized into Table 5.1.22.

Table 5.1.22 Administrative and Functional Classification

Type	Class	Definition
National Road	Class A: Trunk Roads	A national route that links two or more regional headquarters; or an international route that links regional headquarters and other major or important cities or towns or major ports outside Tanzania.
	Class B: Regional roads	Constitute the secondary national routes connecting a trunk road and district or regional headquarters in a region; or connecting regional and district headquarters.
District Roads	Class C: Collector roads	A road linking a district headquarters and a division centre; A road linking a division centre with any other division centre; A route linking a division centre with a ward centre; A road within urban areas carrying through traffic which predominantly originates from and destined out of the town and links with either regional or a trunk road;
	Class D: Feeder roads	A road within urban areas that links a collector road and other minor roads within the vicinity and collects or distributes traffic between residential, industrial and principal business centres of the town; A village access road linking wards to other wards' centres
	Class E: Community roads	A road within a village or a road which links a village to another village.

b) Relationship between the Functional Class and the Design Class

The main requirement is that a road shall function satisfactorily during its service life without major improvements. In terms of serving the users, this requirement implies absence of major delays or breakdowns in the traffic flow on a regular basis during the design life of the project.

To ensure a satisfactory functioning of the road, road design class and a range of geometric design standards may be applicable to one functional class as shown in Table 5.1.23

Table 5.1.23 Relationship between the Functional Class and the Design Class

Design Class	AADT [veh/day] in the design year	Functional Class				
		A	B	C	D	E
DC 1	>8,000					
DC 2	4,000 – 8,000					
DC 3	1,000 – 4,000					
DC 4	400 – 1,000	M				
DC 5	200 - 400		M			
DC 6	50					
DC 7	20					
DC 8	<20					

is applied to roads in flat to rolling terrain.

M: Minimum standard for the appropriate functional class

3) Access Control

Access control is one of the most important means for preserving the efficiency and road safety of major roads. Roads without access control are, however, equally important for road users to be able to access neighbouring facilities of the road. The following three levels of access control are applicable:

- Full access control: - means that access control is exercised by providing access connections with selected public roads only through the prohibition of crossings at grade
- Partial access control: - means that access control is exercised to give preference to through traffic

- Unrestricted access: - means that preference is given to local traffic, with the road serving the adjoining areas through direct access connection
- Road function determines the level of access control needed. The following general guidelines are given for the level of access control in relation to the functional road classification:

Table 5.1.24 Access Control

Functional class	Level of access control	
	Desirable	Reduced
A: Trunk Roads	Full	Partial
B: Regional Roads	Full or Partial	Partial
C: Collector Roads	Partial	Partial or unrestricted
D: Feeder Roads	Partial or unrestricted	Unrestricted
E: Community Roads	Unrestricted	Unrestricted

4) Cross Section Dimension

a) Cross Section Dimension by Design Class

A number of standardised road design classes have been defined as mentioned above. These are shown in Table 5.1.25 where the dimensions of the cross sections for each design class are given. The drawings for the designs are attached in the Annex.

Table 5.1.25 Cross Section Dimension by Design Class

Design Class	Surface	Road reserve width [m]	Roadway width [m]	Carriage way			Shoulder width [m]	Median width [m]
				Width [m]	Lane width [m]	No. of lanes		
DC 1	Paved	60	28-31	2 x 7.0	3.5	≥4	2 x 2.5 *	9 – 12
DC 2		60	11.5	7.5	3.75	2	2 x 2.0	-
DC 3		60	11.0	7.0	3.5	2	2 x 2.0	-
DC 4		60	9.5	6.5	3.25	2	2 x 1.5	-
DC 5		60	8.5	6.5	3.25	2	2 x 1.0	-
DC 6	Gravel or paved	40	8.0	6.0	3.0	2	2 x 1.0	-
DC 7	Gravel	30	7.5	5.5	2.75	2	2 x 1.0	-
DC 8	Earth or gravel	20	6.0	4.0	4.0	1	2 x 1.0	-

b) Typical Cross Section

Table 5.1.26 Cross Section Dimension for a Dual Carriageway, Design Class 1

Design Class	Dimension (m)						Slope (%)		Median* width (m)
	RRw	RWw	Cw	No. of Lanes	Lw	Sw	Csl	Ssl	
1	60	28.0 to 31.0	2x7.0	4	3.5	2.5	2.5	2.5	9.0 to 12.0

** Note that the width of the inner shoulder is included in the width of the median. Recommended width is 0.9 m, minimum requirement is 0.75 meter.*

Table 5.1.27 Cross Section Dimension for Two Lane Paved Roads, Design Class 2 to 5

Design Class	Dimension (m)						Slope (%)	
	RRw	RWw	Cw	No. of Lanes	Lw	Sw	Csl	Ssl
2	60	11.5	7.5	2	3.75*	2.0	2.5	2.5
3	60	11.0	7.5	2	3.50	2.0	2.5	2.5
4	60	9.5	6.5	2	3.25	1.5	2.5	2.5
5	60	8.5	6.5	2	3.25	1.0	2.5	2.5

Table 5.1.28 Cross Section Dimension for Gravel or Earth Roads, Design Class 6 to 8

Design Class	Dimension (m)						Slope (%)		Surface type
	RRw	RWw	Cw	No. of Lanes	Lw	Sw	Csl	Ssl	
6	40	11.5	7.5	2	3.0	1.0	4	4	Gravel or paved
7	30	11.0	7.5	2	2.75	1.0	4	4	Gravel
8	20	9.5	6.0	1	4	1.0	4	4	Earth or gravel

5) Level of Service (LOS)

The level of service expresses the effectiveness of the road in terms of operating conditions. It is a qualitative measure of the effect of traffic flow factors, such as speed and travel time, interruptions, freedom to manoeuvre, driver comfort and convenience, and indirectly, safety and operation costs. In the Road Geometric Design Manual, LOS classification is determined as shown in Table 5.1.29.

Table 5.1.29 Criteria of LOS

Level of service	General Operating Condition	Maximum AADT		
		Flat terrain	Rolling terrain	Hilly/ Mountainous terrain
A	Free flow	1,600	700	300
B	Reasonable free flow	3,200	1,650	700
C	Stable flow	5,200	3,000	1,250
D	Approaching unstable flow	8,700	4,500	1,900
Assumption ✓ Traffic mix 25% of trucks ✓ Directional split 60/40 ✓ Ratio of 30th HHV to AADT 0.15			✓ Flat terrain <20% ✓ Rolling to Hilly terrain 20 - 40% ✓ Mountainous terrain 40 - 60%	

(2) Current Road Situation in DSM

1) Road Network in DSM

Figure 5.1.20 and Figure 5.1.21 illustrates the current major road network under jurisdiction of TANROADS by pavement type, and current road network in CBD. Approximately 44% of all roads under TANROADS are still unpaved.

Mwalimu Nyerere Bridge (Kigamboni Bridge), which was opened in 2016, operates as a toll road by National Social Security Fund (NSSF). The concession period was expected to last for 25-30 years. During that period, operation and maintenance was made by NSSF.

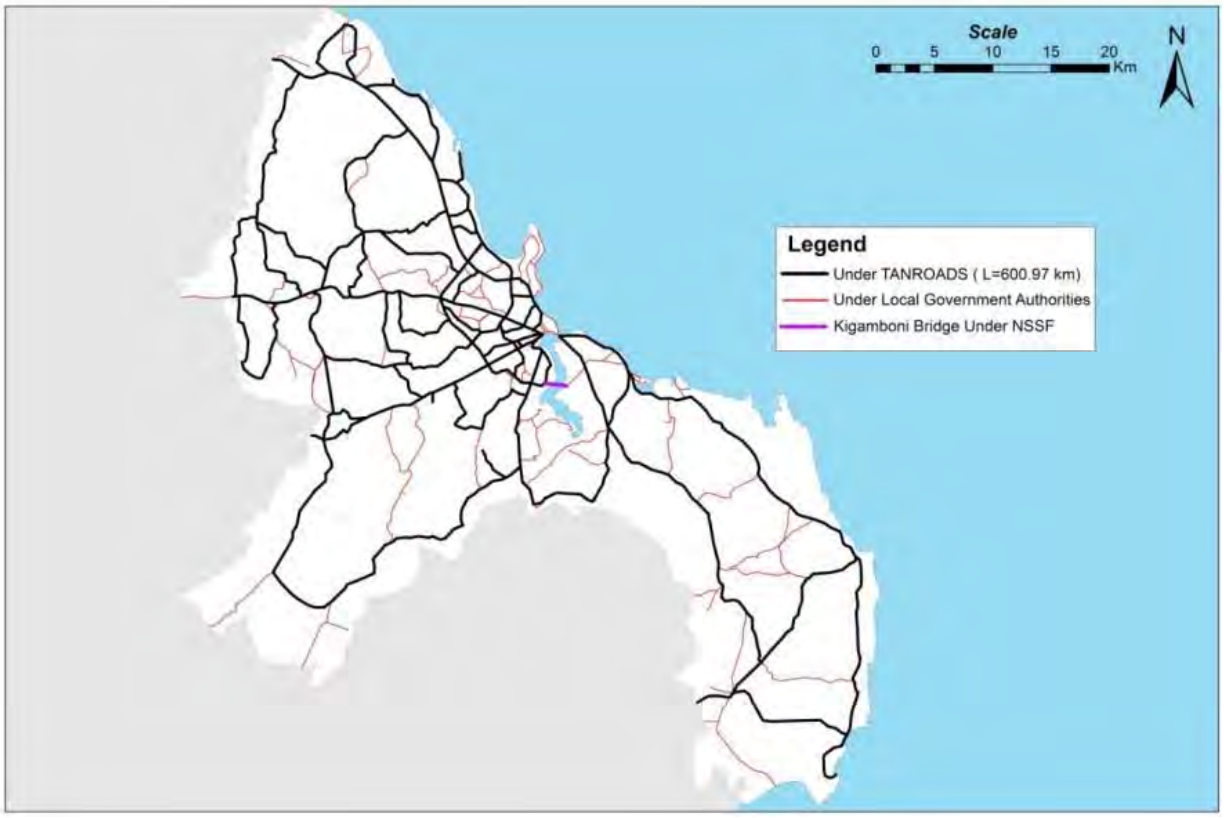


Figure 5.1.20 Major Road Network by Organization

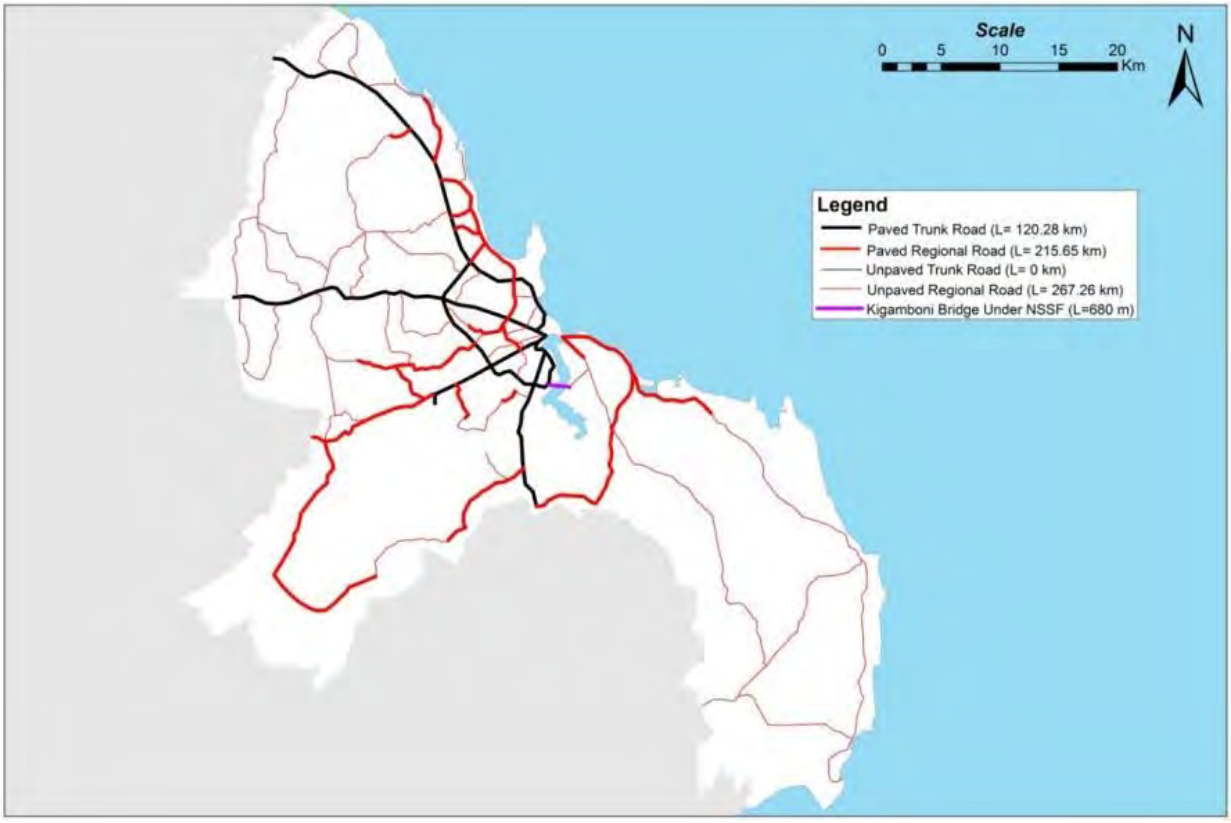


Figure 5.1.21 Road Network under TANROADS by Type of Roads

2) Number of Lanes of Existing Main Road

Figure 5.1.22 illustrates the number of lanes in existing main roads. All roads other than trunk roads consist of two lanes or less.

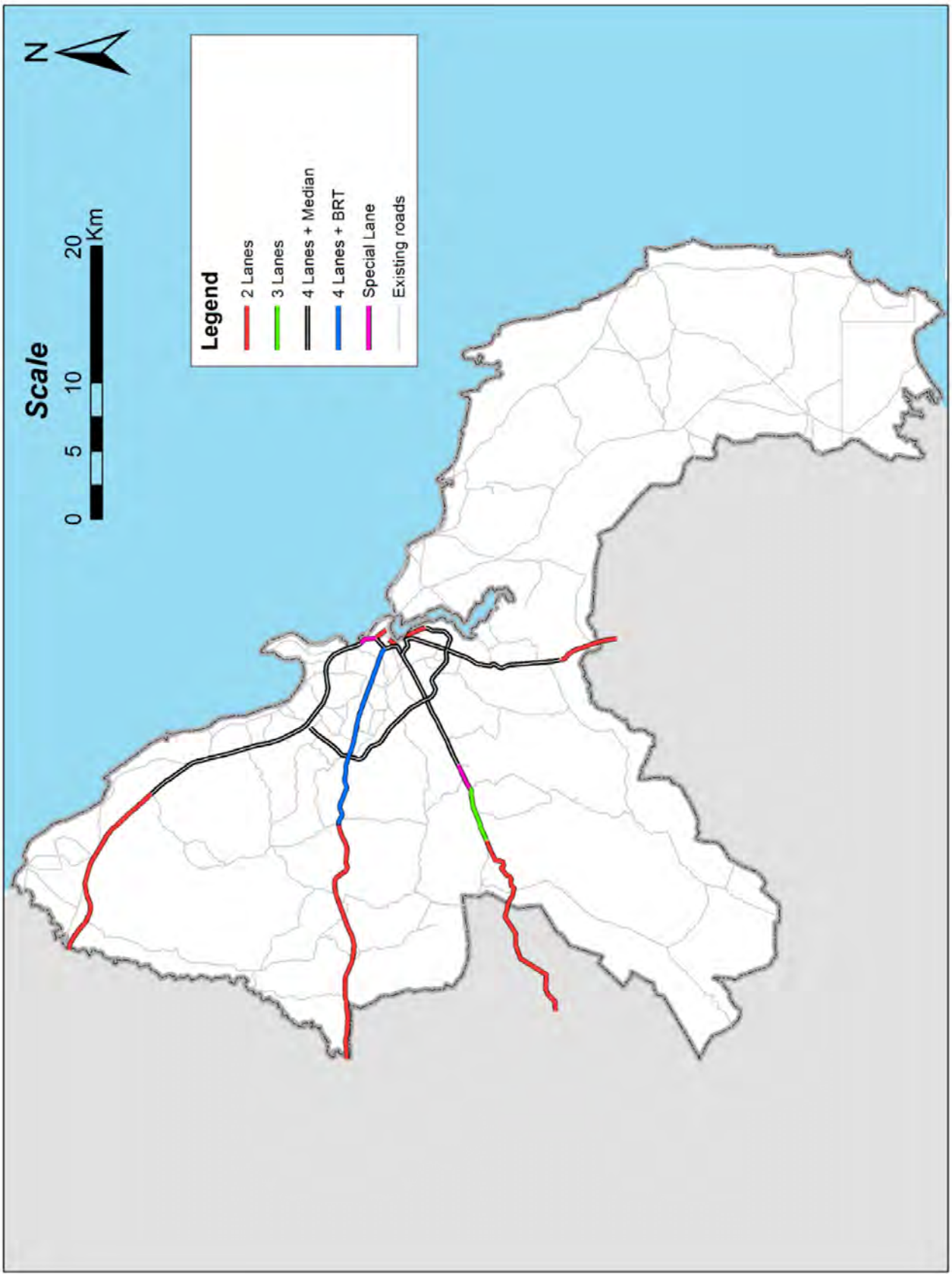


Figure 5.1.22 Number of Lanes of Existing Main Road

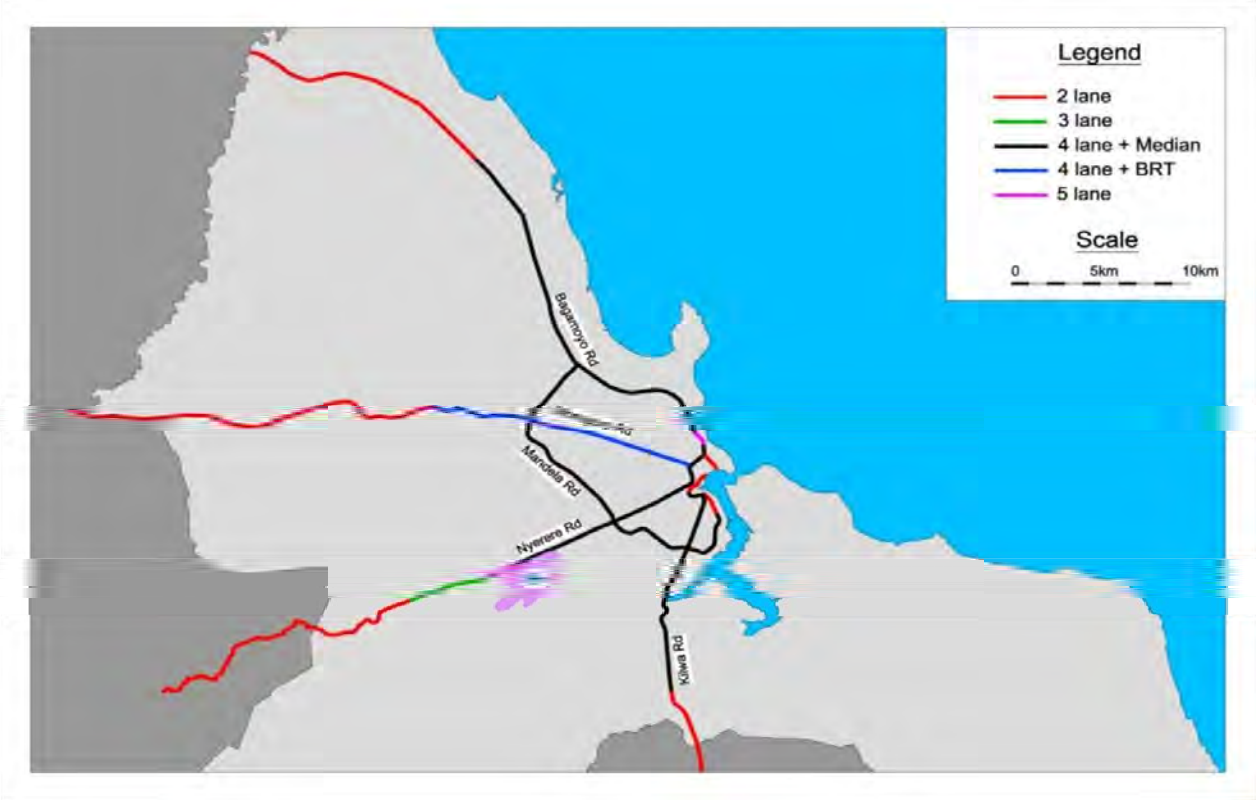


Figure5.1.23 Number of Lanes of Trunk Roads

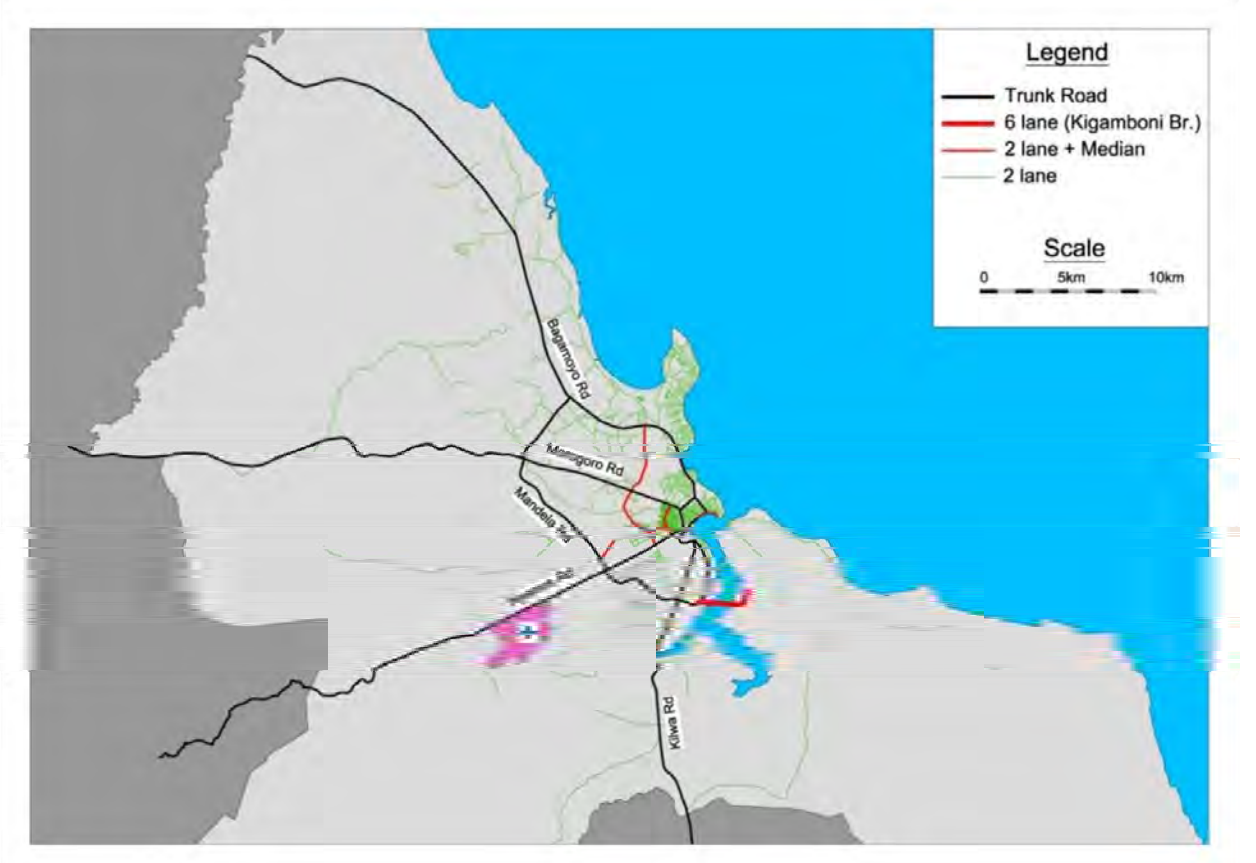


Figure 5.1.24 Number of Lanes of Paved Roads

3) Road Situation in CBD

Road network and roadside facilities in CBD are described in Figure 5.1.25. The bus terminals are near major intersections and 98% of roads are paved. On the other hand, parking lots are provided along the road. Especially in the centre of CBD, there is a lot of parking space in the roadside or in front of buildings.

Figure 5.1.25 Road Network in CBD

(3) Traffic Control

1) At Junction

Traffic control at junctions currently conducted in DSM is indicated in Figure 5.1.26.

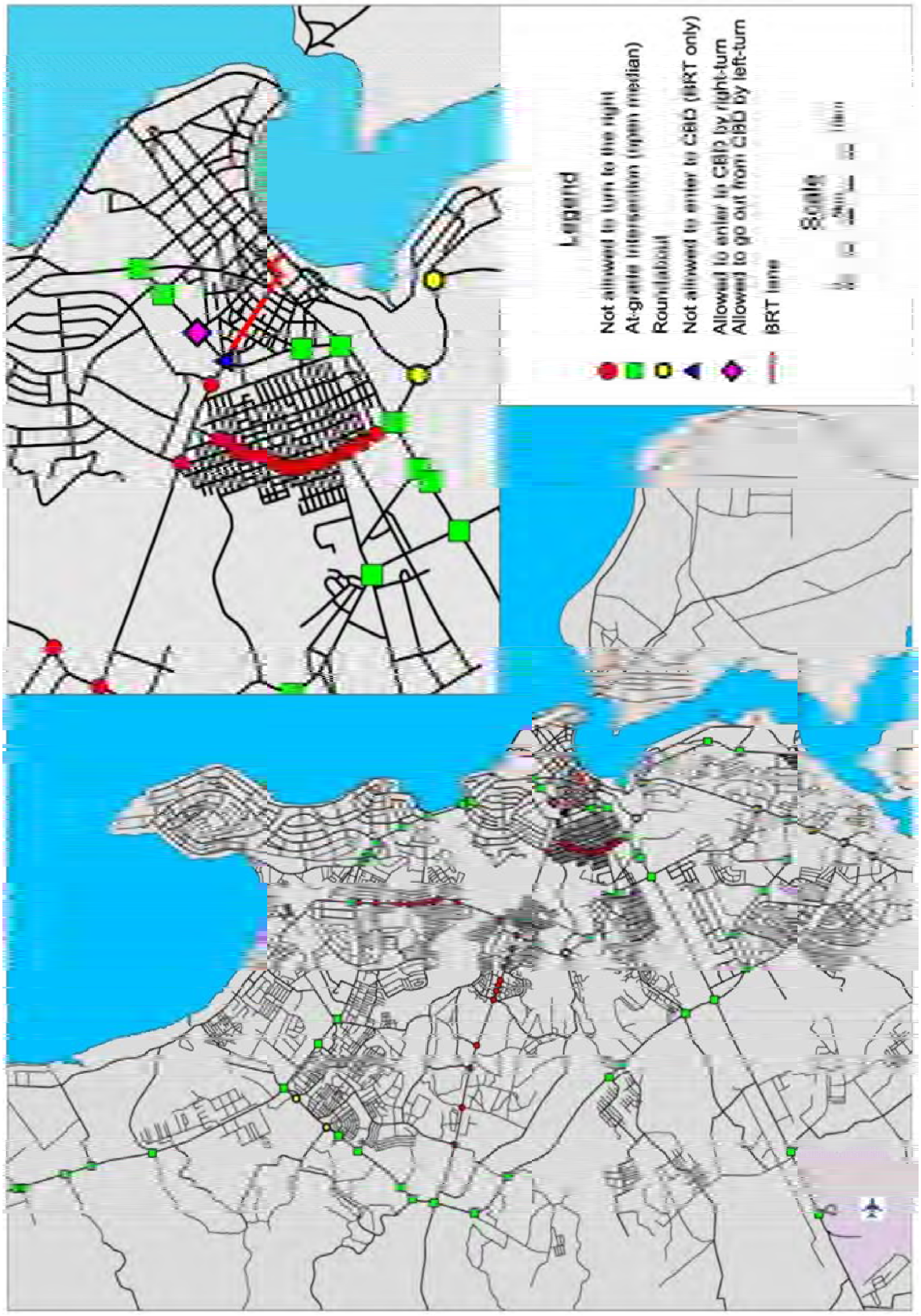


Figure 5.1.26 Traffic Control

2) On Road Sections

Traffic control on Road Sections currently conducted in DSM is indicated in Figure 5.1.27 and Table 5.1.30. There are two (2) sections to be operated and regulated by traffic officers depending on the time.

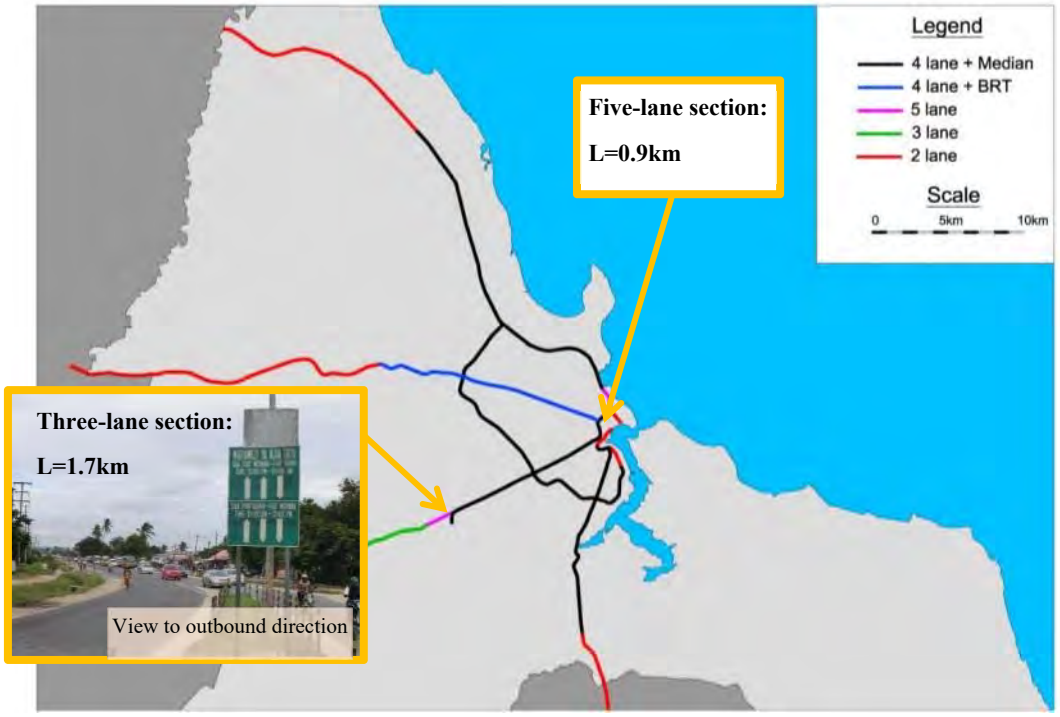


Figure 5.1.27 Special Road Section

Table 5.1.30 Details of Traffic Control Operation

Location	Description	Regulation Time of Use of Centre Lane	Regulated Vehicle	Controlled by
Three-lane section on Nyerere Road	Section of 1.7km leading from the airport to outbound direction	**01:00 - 13:00** Only inbound vehicles **13:00 - 01:00** Only outbound vehicles	All vehicle available*	Traffic police in collaboration with TANROADS and SUMATRA
Five-lane section on Ali Hassan Mwinyi Road	Section of 0.9km leading from the airport to outbound direction	**24 hours** Only for emergency cases or temporary use		

*Heavy trucks are prohibited to enter the city centre at all time without special permit by municipal council.

3) For Heavy Vehicles

Traffic regulation by vehicle weight and time is currently being conducted by SUMATRA in DSM within the highlighted area in Table 5.1.31.

Table 5.1.31 Traffic Regulation for Heavy Vehicle

Vehicle Type	Gross Weight	Allowed section	Allowed Time	Regulated Area
Small Truck	3.5 tons or less	All area	24hrs	
Medium Truck	3.5 to 10 tons	Regulated area	18:00 - 5:00	
		Other areas	24hrs	
Heavy Truck	10 tons or more	Not allowed to be in Tanzania	-	

4) Overloaded Management

Overloaded management is currently being conducted by TANROADS along Trunk Roads by using mobile truck scale.

(4) Review on Road Development Project Proposed by JICA Urban Transport Master Plan in 2008

Results of the review on road development project proposed by JICA-UTMP in 2008 are summarized in Table 5.1.32, and project locations in the table are plotted on the Figure in the Annex in accordance with Project Number.

Table 5.1.32 Result of Review on Road Development Project Proposed by JICA-UTMP in 2008

Project List proposed by JICA-UTMP in 2008			Result of Review as of December 2016	
Project No.	**Project Name**	**Priority given**	**Responsible Organization**	**Status**
101	New Bagamoyo Road Widening		TANROADS	Completed
102	Nelson Mandela Road Widening		TANROADS	No Progress
103	Mwalimu Nyerere Bridge (Kigamboni Bridge) and Access Road Improvement	★	TANROADS	On-going
104A	Inner Ring Road/Kawawa Road Development	★	TANROADS	Completed
104B	Inner Ring Road/Kawawa Road Development	★	TANROADS	Basic Design Completed
105	Nyerere Road Widening		TANROADS	No Progress
106	Outer Ring Road Development		TANROADS	Detailed Design Completed
107	BRT Phase 1 Corridor and Road Development		TANROADS	Completed
108	BRT Phase 1 Corridor and Road Development		TANROADS	Completed
109A	Gerezani Area Transport Enhancement	★	TANROADS	Basic Design Completed
109B	Gerezani Area Transport Enhancement		TANROADS	No Progress
110	Selander Bridge Bypass	★	TANROADS	Project Financing
111	Kigamboni Corridor Road Development		TANROADS	No Progress
112	BRT Phase I (Morogoro Road)	★	DART	Completed

Project List proposed by JICA-UTMP in 2008			Result of Review as of December 2016	
Project No.	**Project Name**	**Priority given**	**Responsible Organization**	**Status**
	BRT Phase II (Kilwa Road)		DART	Under Project Financing
	BRT Phase III (Nyerere Road)		DART	Under Project Financing
113	Flyover Installation – Tazara	★	TANROADS	On-going
	Flyover Installation – Ubungo		TANROADS	Under Procurement
	Flyover Installation – Mwenge		TANROADS	No Progress
	Flyover Installation - Kawawa-Nyerere		TANROADS	Under Project Financing
114	CBD Traffic Management (7 Signalized Intersections)	★	TANROADS	Detailed Design Completed
115A	Expressway (Wazo-Sam Nujoma)		TANROADS	Feasibility Study Completed
115B	Expressway (Wazo-Sam Nujoma)		TANROADS	Feasibility Study Completed
116	Expressway (Sam Nujoma-Airport)		TANROADS	Feasibility Study Completed
117	Expressway (Sam Nujoma-Airport)		TANROADS	Feasibility Study Completed
118	Expressway (Sam Nujoma-Airport)		TANROADS	Feasibility Study Completed
119	Expressway (Airport-Kigamboni)		TANROADS	Feasibility Study Completed
120	Mikocheni Road Widening		Not Specified	No Progress
121	Haile Selassie Street Widening		Not Specified	No Progress
122	Old Bagamoyo Road Widening		TANROADS	Basic Design Completed
123	Mwinyijuma Road Widening		Kinondoni MC	No Progress
124	Shekilango Road Widening		TANROADS	No Progress
125A	Kigamboni Road Development 7		Not Specified	No Progress
125B	Kigamboni Road Development 8		Not Specified	No Progress
126	United Nations Road Widening		TANROADS	No Progress
127	Morogoro Road Bypass (North)		Not Specified	No Progress
128	Morogoro Road Bypass (South)		Not Specified	No Progress
129	Uhuru Street Widening		TANROADS	No Progress
130	Kimanga/Tabata Road Widening		TANROADS	No Progress
131	Tabata Road Development		TANROADS	No Progress
132	Chang'ombe/Tandika Road Widening		Temeke MC	Under Planning
133	Mbagala/Tandika Road Widening		Temeke MC	Detailed Design Completed
134	Mbagala Road Widening		Temeke MC	No Progress
135	Sam Nujoma Road Extension		TANROADS	No Progress
136	Kibada Road Widening		TANROADS	On-going
137	Kigamboni Road Widening		TANROADS	No Progress
138	Kigamboni Road Development 1		Kinondoni MC	No Progress

Project List proposed by JICA-UTMP in 2008			Result of Review as of December 2016	
Project No.	**Project Name**	**Priority given**	**Responsible Organization**	**Status**
139	Kigamboni Road Development 2		Kinondoni MC	No Progress
140	Kigamboni Road Development 3		Kinondoni MC	No Progress
141	Kigamboni Road Development 4		Kinondoni MC	No Progress
142	Kigamboni Road Development 5		Kinondoni MC	No Progress
143	Kigamboni Road Development 6		Kinondoni MC	No Progress
144	Vijibweni Road Widening/Development		Kinondoni MC	No Progress
145A	New Bagamoyo Road Extension		TANROADS	No Progress
145B	New Bagamoyo Road Extension		TANROADS	No Progress
146	Upanda Road Improvement		Not Specified	No Progress
148	Msasani Area Road Improvement		Not Specified	No Progress
149	Regent Area Road Development		Not Specified	No Progress
150	Old Bagamoyo Road Extension		TANROADS	No Progress
151	Kinondoni Regional Road Development		Not Specified	No Progress
152	Kinondoni Regional Road Development 2		Not Specified	No Progress
153	Ilala Regional Road Development		TANROADS	No Progress
154	Ilala Regional Road Development 2		Not Specified	No Progress
155	Temeke Regional Road Development		Not Specified	No Progress
156	Temeke Regional Road Development 2		Not Specified	No Progress
157	Temeke Regional Road Development 3		Not Specified	No Progress
158	Corridor and Road Development 3		Not Specified	No Progress
159	Tandika Area Road Improvement		Temeke MC	No Progress
160	Industrial Area Road Improvement		Temeke MC	No Progress
161	Tabata Area Road Improvement		TANROADS	Basic Design Completed
162	Flyover Installation (Phase2)		TANROADS	No Progress

(5) Issues and Problems

1) Overview

The current issues and problems that DSM faces in road transport sector were analysed. Negative factors were identified, analysed and categorised into three types: Mobility, Accessibility and Safety, as shown in Figure 5.1.28 which illustrates the locations of them in DSM. Each of these negative factors is complicated and deeply interconnected. Therefore, comprehensive and systematic measures are required.

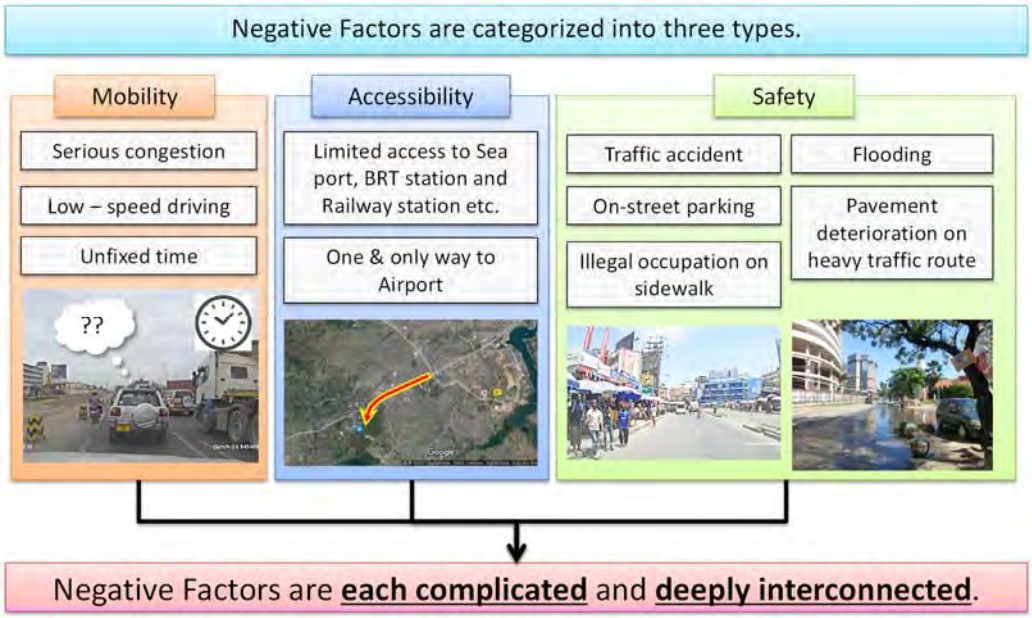


Figure 5.1.28 Analysis Result of Traffic Problem

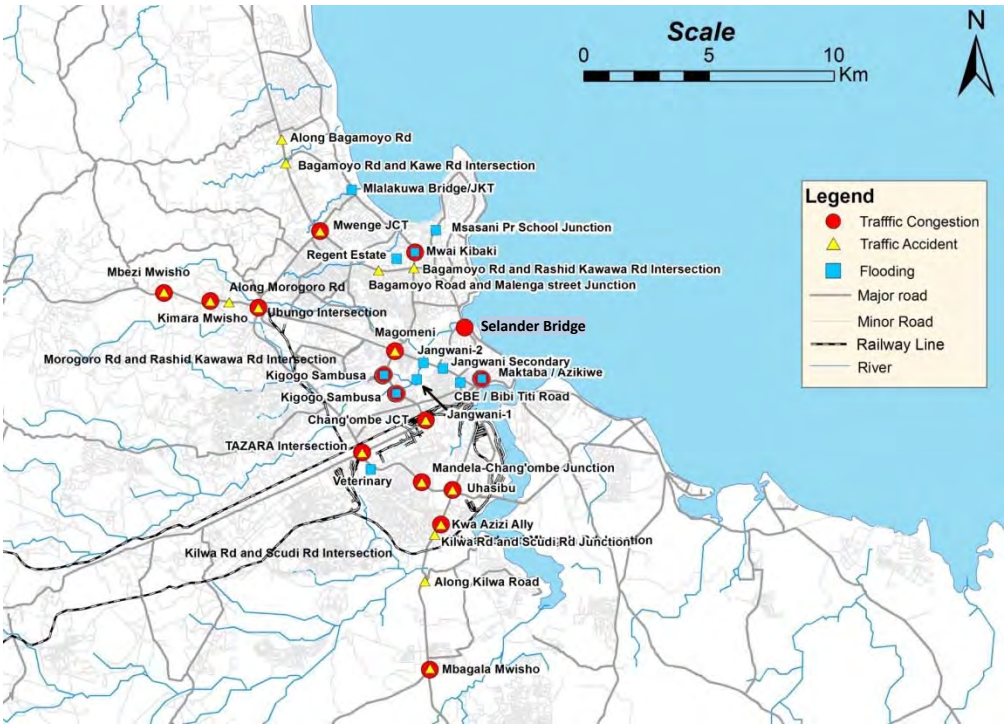


Figure 5.1.29 Location Map Showing Traffic Problems

2) Traffic Problem on Mobility

a) Serious Traffic Congestion of Trunk Road during Peak Hour

Serious traffic congestion occurs at the major intersections and entrances to CBD during peak hours in the morning and evening. On the other hand, chronic traffic congestion occurs in Slander Bridge, Ubungo Intersection and TAZARA Fly-over, which is being constructed. Since existing Trunk Roads in DSM such as Bagamoyo Road, Morogoro Road, Nyerere Road and Mandela Road do not have alternative routes as detours. Due to insufficiency of alternative routes, existing traffic is not able to take alternatives and is forced to take the Trunk Roads. Nelson Mandela Road is the first road to pass through by vehicles heading to DSM, taking the radial roads connecting to other Trunk Roads and back. Heavy traffic heading to DSM, which is highly affected by traffic flow and operation, need to pass through the intersections of crossing points between radial roads and ring road. Table 5.1.33 shows current volume-to-capacity ratio at the cross section at the inflow lane of the Trunk Roads. It was calculated based on the latest traffic volume and traffic capacity determined in the Road Geometric Design Manual. Calculation of current traffic volume was based on the traffic count data conducted in 2017. The results indicate that the current situations of all Trunk Roads exceed their traffic capacity. This means that Trunk Roads are already over capacity.

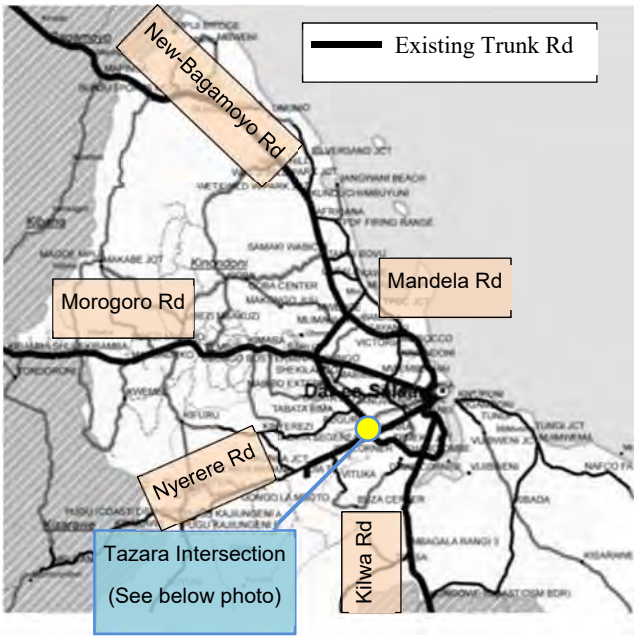


Figure 5.1.30 Insufficiency of Alternative Route

Table 5.1.33 Volume-to-Capacity Ratio Check for Current Situation of Trunk Road

Serial No. assigned by TANROADS		T1	T7	T24	T25	T26
Road Name		Morogoro	Kilwa	Nyerere	Mandela	Bagamoyo
Photo						
Max. AADT [pcu / day]		46,500	52,500	50,000	43,000	72,700
Number of Lanes		4	4	4	4	4
Traffic Capacity	LOS : A	6,400				
	LOS : B	12,800				
	LOS : C	20,800				
	LOS : D	34,800				
Volume-to-capacity ratio (=AADT / Traffic Capacity [LOS=D])		**1.34**	**1.51**	**1.44**	**1.24**	**2.09**

Intersections shown in Table 5.1.34 are major traffic congestion roads and bottlenecks.

Table 5.1.34 Major Traffic Congestion Road and Bottlenecks

Type	Name of Road / Intersection	Remarks
Road	Old Bagamoyo	
	Mwaikibaki Road	
	Morogoro Road	Mbezi Mwisho to Kimara
	Mbagala along Kilwa Road	
	Gongo la Mboto along Pugu Road	
	All major roads in the CBD	
Intersection	Mwenge	New Bagamoyo / Sam Nujoma Roads
	Morocco	New Bagamoyo / Kawawa Roads
	Selander Bridge	Alli Hassani Mwinyi / United Nations Roads
	Ubungo	Mandela / Morogoro Roads
	Magomeni	Morogoro / Kawawa Roads
	Fire station	Morogoro / United Nations Roads
	Tabata	Mandela / Tabata – Kinyerezi Roads
	Buguruni	Mandela / Uhuru Roads
	Tazara	Mandela / Nyerere Roads
	Kilwa / Mandela roads Jct,	Kilwa / Mandela Roads
	Chang'ombe	Nyerere / Kawawa Roads
	Banana Junction along Pugu Road	

b) Low Travel Speed and Long Travel Time

According to the traffic survey result conducted in 2017 as shown in Table 5.1.35 and Table 5.1.36, it was found that average travel speed gets slower especially on the Bagamoyo Road and Nyerere Road, and it takes more than one hour within a radius of 10 km from CBD during morning peak hours.

Table 5.1.35 Average Travel Speed

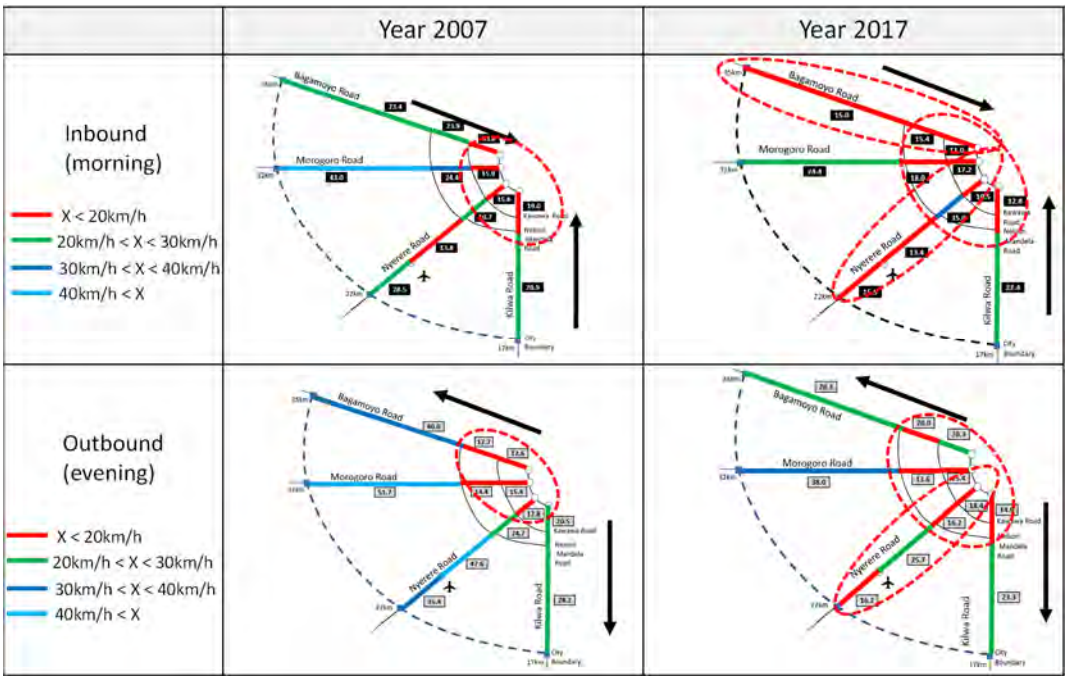
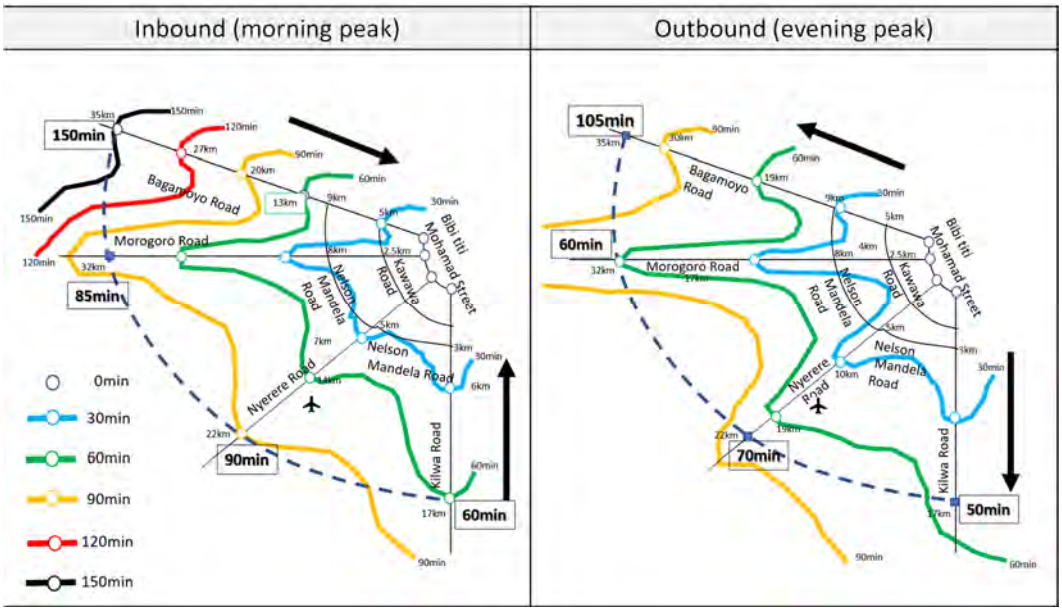


Table 5.1.36 Average Travel Time during Peak Hour



c) Reduction of Traffic Capacity and Increase of Accident Risk due to Inadequate Use of Road

Inadequate use of roads such as on-street parking and illegal occupation of sidewalk for small businesses causes reduction of traffic capacity. As shown in following Photos, a lot of on-street parking vehicles can be seen in CBD and it badly affects existing traffic flow and safety. Although traffic volume has been increasing in CBD, enough parking lots have not been secured. Therefore, some roads are obliged to be operated as one-way traffic. Even in suburban areas, traffic capacity is being reduced by blocking the roads by queue of Dara-Dara in the below photo as well.

Photos: Reduction of Traffic Capacity and Increase of Accident Risk

In studying traffic capacity for uniterrrupted flow segmanet according to HCM, a saturation flow rate is used as a basis capacity of the road. It is adjusted by multiplying various factors as decribed below based on the traffic condition.

$$s = s_0 \cdot N \cdot f_w \cdot f_{HV} \cdot f_g \cdot f_p \cdot f_{bb} \cdot f_a \cdot f_{LU} \cdot f_{LT} \cdot f_{RT} \cdot f_{Lpb} \cdot f_{Rpb}$$

s : saturation flow rate for subject lane group, expressed as a total for all lanes in lane group (veh/h)
s_0 : base saturation flow rate per lane (pc/h/ln)
N : number of lanes in lane group
f_w : adjustment factor for lane width
f_{HV} : adjustment factor for heavy vehicles in traffic stream
f_g : adjustment factor for approach grade
f_p : adjustment factor for existence of a parking lane and parking activity adjacent to lane

group
f_{bb} : adjustment factor for blocking effect of local buses that stop within intersection area
f_a : adjustment factor for area type
f_{LU} : adjustment factor for lane utilization
f_{LT} : adjustment factor for left turns in lane group
f_{RT} : adjustment factor for right turns in lane group
f_{Lpb} : pedestrian adjustment factor for left-turn movements
f_{Rpb} : pedestrian-bicycle adjustment factor for right-turn movements

Here, based on the current situation in DSM, a rough study on Capacity Reduction Factors (CRF) was conducted forcusing on the f_w, f_p, f_{bb} and f_a. The results are summarized in Table 5.1.37.

Table 5.1.37 Study Result

No.	Formula	Definition	Input Data	Capacity Reduction Factor (CFR)
1	$f_w = 1 + \frac{(W - 3.6)}{9}$	W: lane width (m)	$\boldsymbol{W = 1.8}$ Assuming that half of lane width (1.8m) is occupied by on-street parking	**80%**
2	$f_p = \frac{N - 0.1 - \frac{18N_m}{3600}}{N}$	N: number of lanes in lane group N_m: number of parking maneuvers / hour	$\boldsymbol{N = 1,\ N_m = 10}$ Objective roads in CBD has just one lane a direction Assuming that 10 times of parking maneuvers are done within a hour on the same road segment	**85%**
3	$f_{bb} = \frac{N - \frac{14.4N_B}{3600}}{N}$	N: number of lanes in lane group N_B: number of buses stopping / hour	$\boldsymbol{N = 1, N_B = 20}$ Objective roads in CBD has just one lane a direction Assuming that a Dara-Dara stops 20 times per hour	**92%**
4	$f_a = 0.900\ in\ CBD$	-	-	**90%**

Table 5.1.38 Trial CRF Calculation for Typical Crosse Section

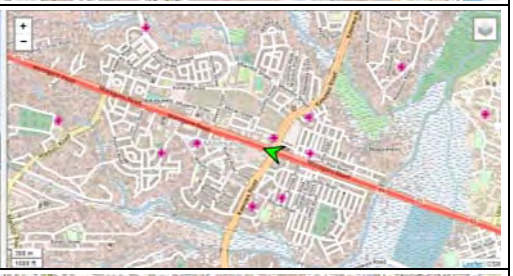
Photo		
Applied	No.1, 2 and 4 are applied	No.1, 2 and 3 are applied
CFR	CRF = 80% * 85% * 90% = 61%	CRF = 80% * 85% * 92% = 63%

d) Traffic Restraint due to Existence of BRT Lane

Since BRT is in operation with high priority, general road traffic is restrained from turning to the right at intersections. Motorists are not allowed to make right-turns in the intersection as indicated in Table 5.1.39 and have to take alternative route for a long distance. Thus, passenger cars concentrate on the intersection available for right-turn, which then leads to traffic congestion.

Table 5.1.39 Intersection not to be Allowed for Right-Turn

Location

No.	Photo and Detailed Location
1	 
2	 
3	 
4	 
5	 

3) Traffic Problems on Accessibility

a) Low Density Roads in Suburbs

The spread of urban areas to suburban areas, which is caused by rapidly increasing population, has led to disorderly urbanization in the western side of Mandela Road. With this change, road infrastructure is still under poor condition. Figure 5.1.31 shows an existing road network, which is composed of four-lane roads (102km) and paved two-lane roads (536km).

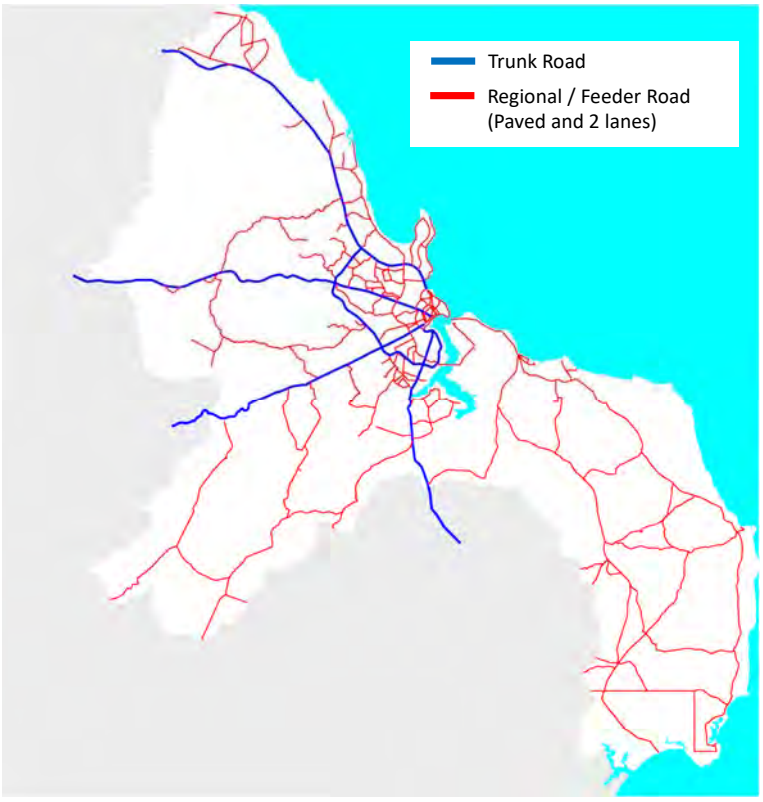
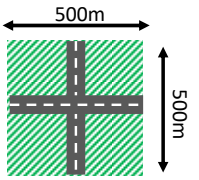
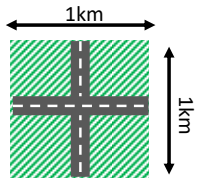
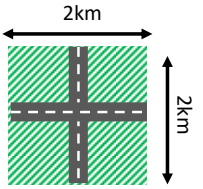


Figure 5.1.31 Existing Road Network

Road density is calculated by dividing total road length by target area. General criteria of road density are given by type of area as shown in Table 5.1.40. From Figure 5.1.32, current road density outside of Mandela road is lower than the criteria.

Table 5.1.40 General Criteria of Road Density

Type of Area	Road Density	Description
Residential area	2 to 4km / km^2	**Road Density = 4 (km / km^2) → 500m mesh** 
Business district	5 to 7km / km^2	**Road Density = 2 (km / km^2) → 1km mesh** 
Industrial zone	1 to 2km / km^2	**Road Density = 1 (km / km^2) → 2km mesh** 

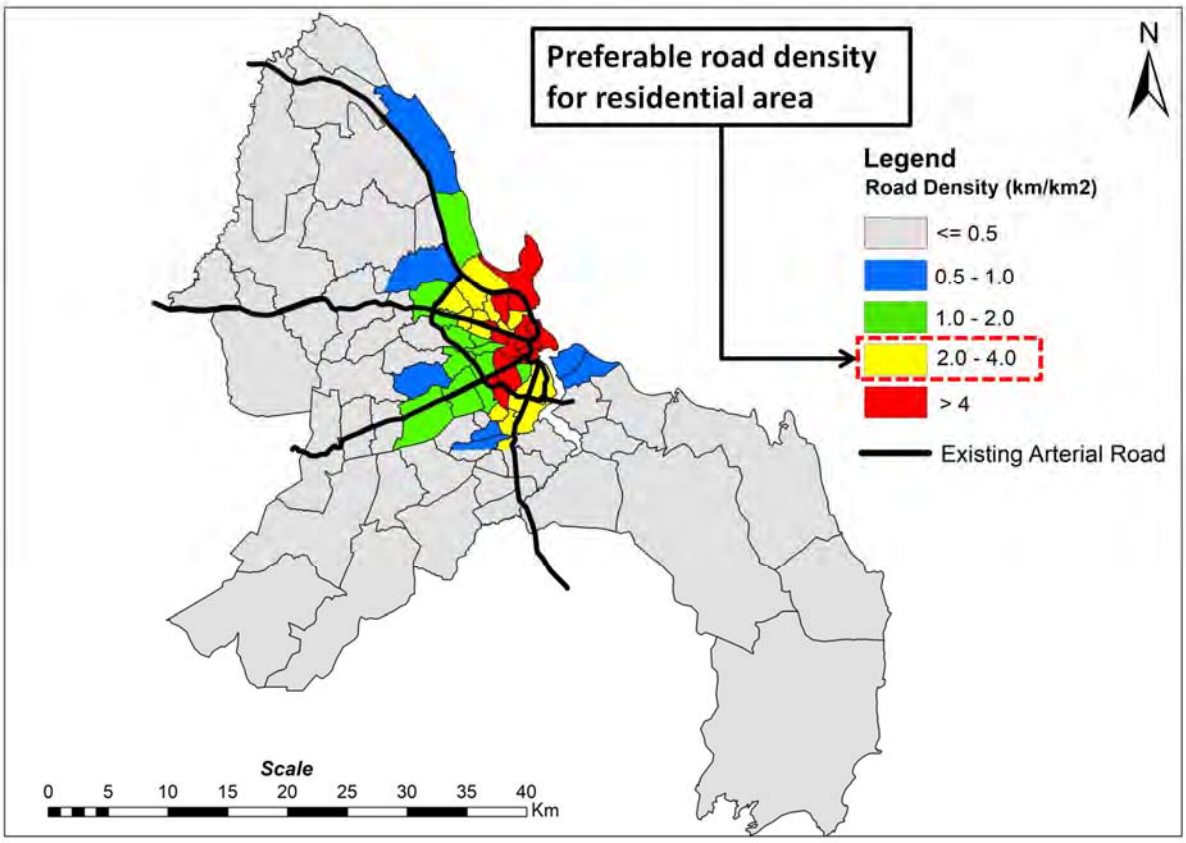


Figure 5.1.32 Current Road Density by Wards

b) Authorized projects to be planned far away from CBD

Figure 5.1.33 describes the authorized road project layout. The outer ring road and expressway were planned 20–30km away from the CBD. In addition, there are some missing links in the road network formulated by the authorized projects as shown in Figure 5.1.34. In case that only these projects will be implemented, it would be difficult and inconvenient for the road users to access to the roads.

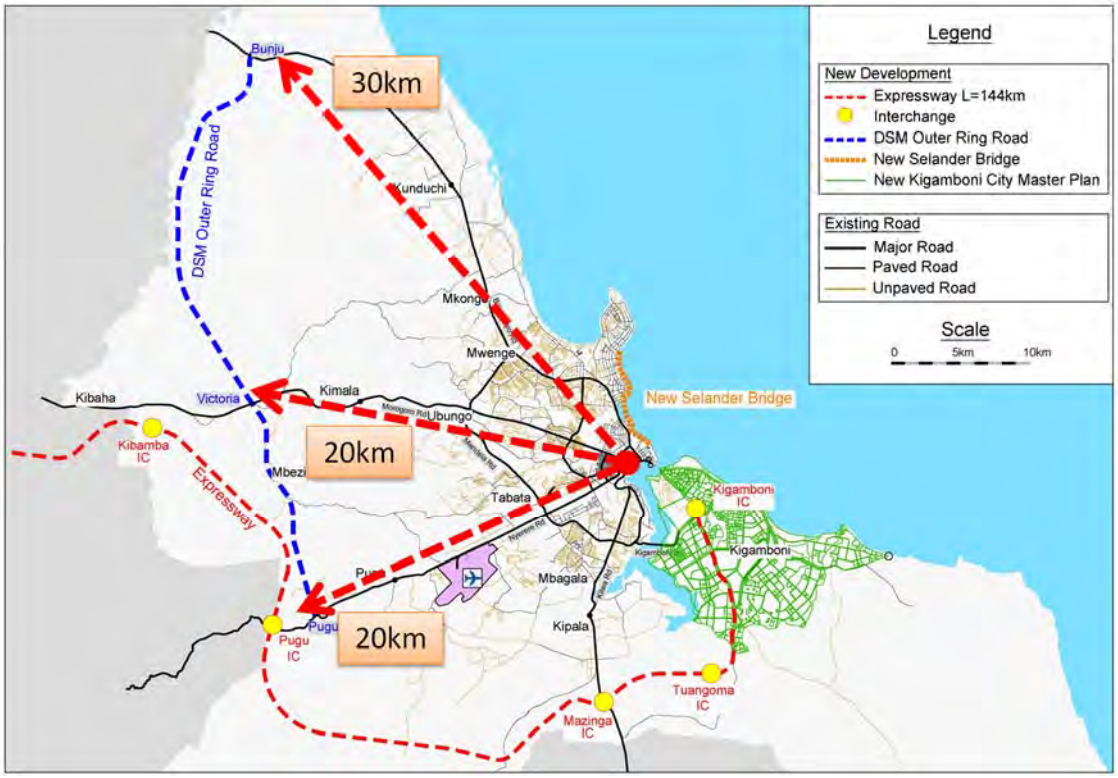


Figure 5.1.33 Authorized Projects to be Planned far away from CBD

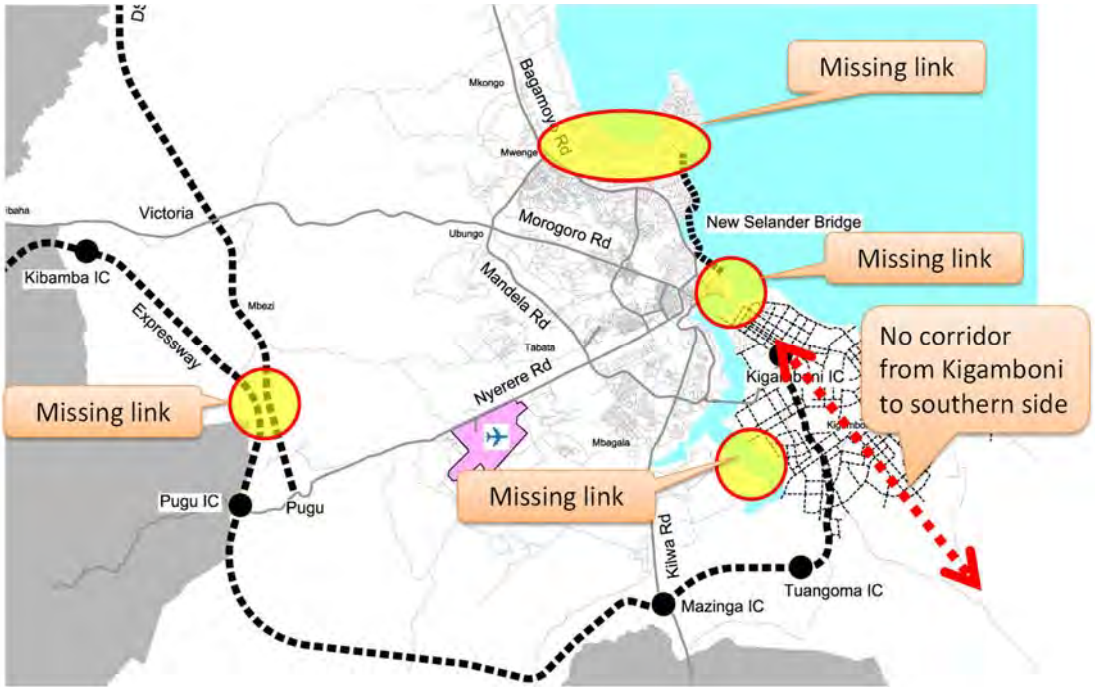


Figure 5.1.34 Missing Links

4) Traffic Problem on Safety

a) Traffic Accident

According to the traffic accident statistical data in Figure 5.1.35 from RAIS (Road Accident Information System), 1,626 accidents in total occurred in DSM in 2016. Noteworthy, collision at junction accounts for 25% of them. As highlighted by red lines in the distribution map traffic accident site, most traffic accidents occurred along the major roads and junction.

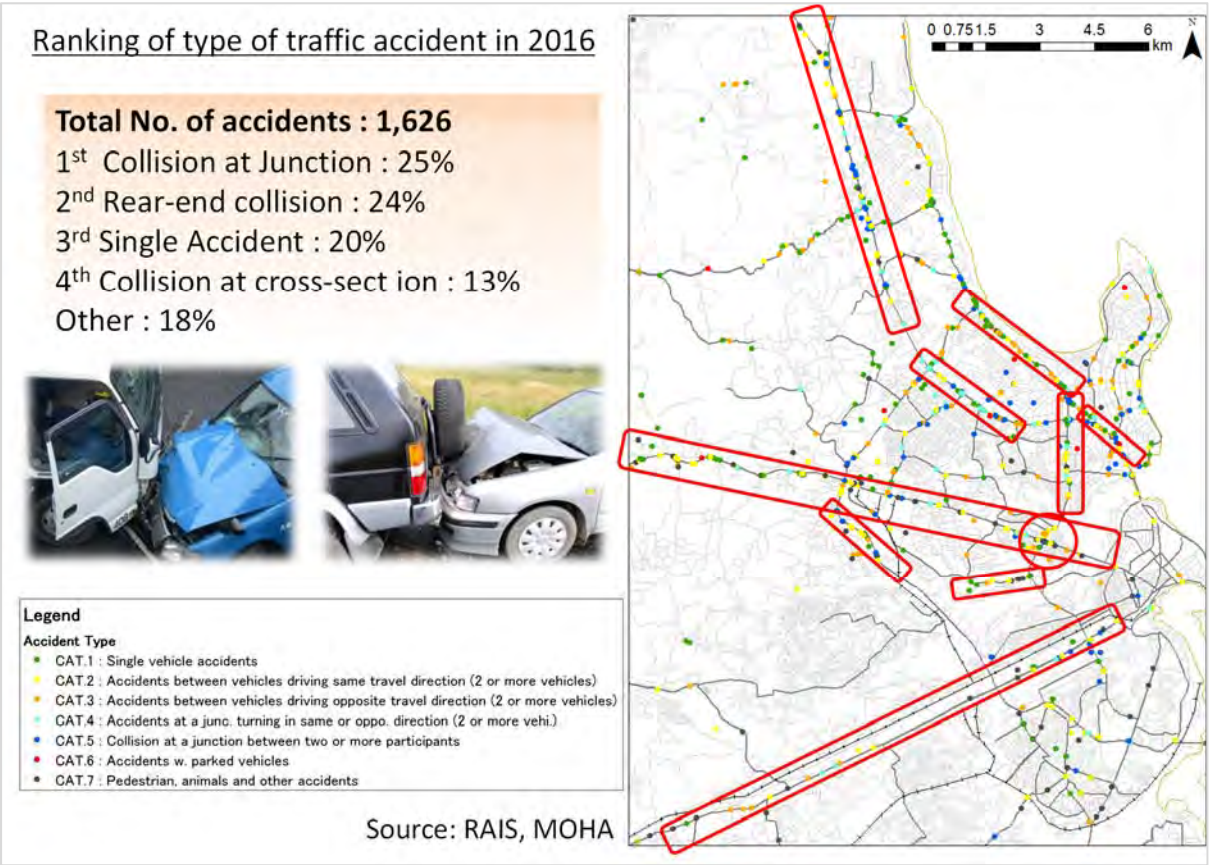


Figure 5.1.35 Traffic Accident Data Summary

b) Flooding due to Insufficient Drainage Capacity

As mentioned above, there are a lot of flood-prone spots in DSM due to insufficient drainage capacity. The actual situation of flooding as of late that has occurred in Jangwani Bridge on Morogoro Road is shown below.

On the 8th of March 2017, it started raining from 8:30 and continued for one hour with 30mm to 40mm rainfall strength. Around three hours later, maximum discharge was seen in Jangwani Bridge.

Figure 5.1.36 shows 'before–after' of flooding area around Jangwani Bridge on the 8th of March 2017, 12:30. During this time, BRT lane was completely disrupted, and a bus was not able to move. Furthermore, a BRT depot had been closed for two days due to being flooded since the time of flooding occurrence.

Figure 5.1.36 Jangwani Bridge on Morogoro Road on 8 March 2017, 12:30

Figure 5.1.37 Jangwani Bridge on Morogoro Road on 9 March 2017, 10:30

c) Insufficient Drainage System

Flood-prone areas seen in CBD are shown in Figure 5.1.38. Some roads have no drainage facilities or have drainages with low capacity. In particular, flooding occurs in a border between roadside and private plot, and intersection due to absence of drainage facilities. Condition of drainages as of 2010 is summarized in Table 5.1.41. Flooding causes traffic congestion due to drivers slowing down and traffic accidents.


[After rain]


[Unfunctional Catch Basin]


[Poor Drainage]

Figure 5.1.38 Current Situation in CBD

Table 5.1.41 Condition of Drainage

Ilala Municipal Council				
Type of Storm Water Drainage	Condition			
	Good (km)	Fair (km)	Poor (km)	Total (km)
Lined	40	8	12	60
Unlined	-	-	42	42
Underground	5	12	38	55
Total	45	20	92	157
Kinondoni Municipal Council				
Type of Storm Water Drainage	Condition			
	Good (km)	Fair (km)	Poor (km)	Total (km)
Lined	258	-	15	273
Unlined	-	-	145	145
Underground	15	-	10	25
Total	273		170	443
Temeke Municipal Council				
Type of Storm Water Drainage	Condition			
	Good (km)	Fair (km)	Poor (km)	Total (km)
Lined	104	-	24	128
Unlined	-	-	87	87
Underground	-	-	10	10
Total	104	-	121	225
TOTAL DSM CITY	**422**	**20**	**383**	**825**

Source: DSM Infrastructure Development Programme, 3rd May, 2010

d) Deterioration of Pavement Structure

Depending on the existence of drainage facilities along the road, it can be seen that pavement structure is in several different conditions.

Figure 5.1.39 Observation on Pavement Structure

e) Insufficient Traffic Safety Facility for Pedestrian

Mixture of vehicles and pedestrian on the road way, particularly in CBD and on local roads, can be seen in following Photos.

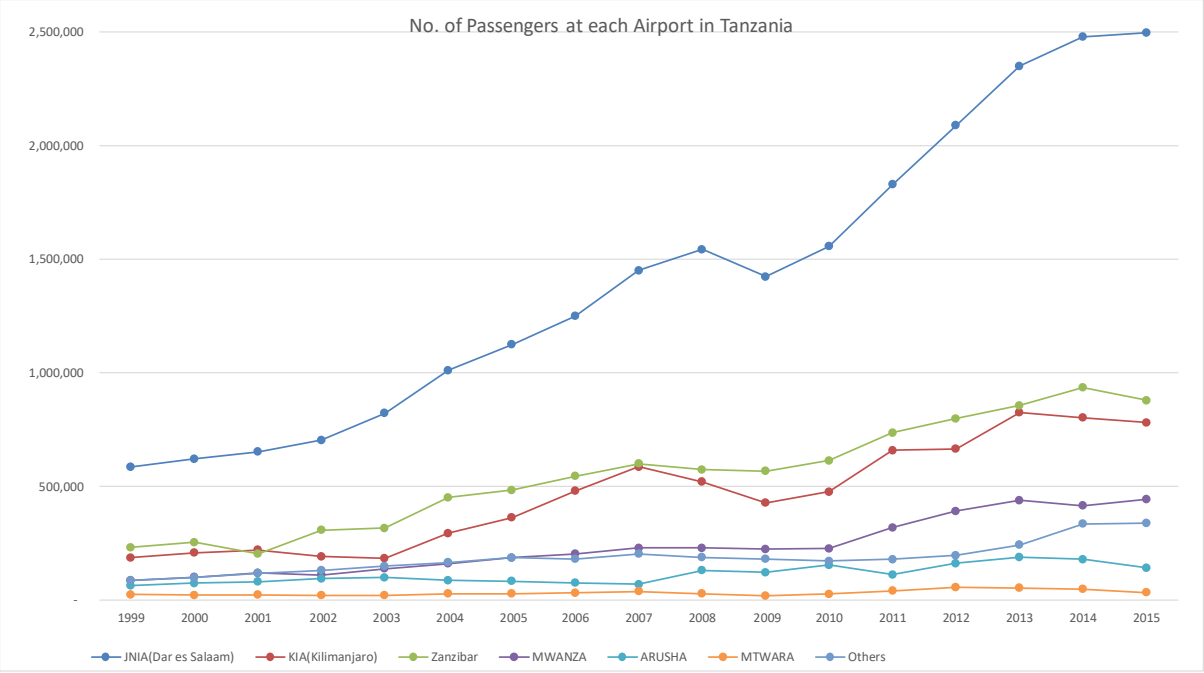
Photo: Insufficient Traffic Safety Facility for Pedestrian

5.1.4 Airport, Port, Waterway

(1) Airport

At present, there are over five million air passengers a year at all airports in Tanzania as listed in Annex. The passengers are concentrated at five airports: DSM, Kilimanjaro, Zanzibar, Arusha and Mwanza. The majority of other airports cater to a small volume of passengers.

Air cargo has been limited to few airports in Tanzania with the majority of cargoes throughput at Julius Nyerere International Airport (JNIA). In 2011, JNIA handled about 89% of the total air freight handled at all TAA airports. From 2005 to 2011, air freight at JNIA increased by an average of 8.7% a year from about 14,000 tons to 23,000 tons a year. The bulk of the freight comprises imports which total about 90% of the volume by weight. Approximately a third of the volume consists of machinery and electrical goods, a fifth consists of glass and stoneware and the remainder comprising miscellaneous freight. Exports largely comprise of animal and animal products, machinery and metals.



Source: Tanzania Airport Authority

Figure 5.1.40 Number of Passengers at Each Airport in Tanzania

Air cargo has been limited to few airports in Tanzania with the majority of cargo throughput at Julius Nyerere International Airport (JNIA). In 2015, JNIA handled about approx. 50% of the total air freight handled at all TAA airports. From 2010 to 2014, air freight at JNIA increased by an average of 12.3% a year from about 129,000 tons to 272,000 tons a year.

(2) Port

DSM port is Tanzania's principal port with an intrinsic capacity of 10.1 million tons per annum. The port handles over 92 of the total maritime ports' throughput. The port serves land linked countries of Malawi, Zambia, Democratic Republic of Congo, Rwanda, Burundi and Uganda. These countries are connected to the port through two railway systems (TRC-1.0 metre gauge and TAZARA-1.067 cape gauge), road network as well as TAZAMA pipeline to Zambia.

The entrance to the port can be accessed through a 2.8km channel which is approximately 140m in width. The channel was last dredged in 1998 when it was deepened, widened, and straightened to

cater to vessels of up to 9.4m in depth and 200m in length at all states of the tide but passage of larger vessels is possible during high tide. The port has 11 berths totalling to about 2,000m in length, two berths at an adjacent oil jetty and a single point mooring located outside the port approximately 3km offshore.

TPA operates berths one to seven which are used for handling break bulk, containers, RoRo and dry bulk cargo while berths eight to 11 comprise the container terminal and are used by TICTS under a concession agreement.

Source: TPA

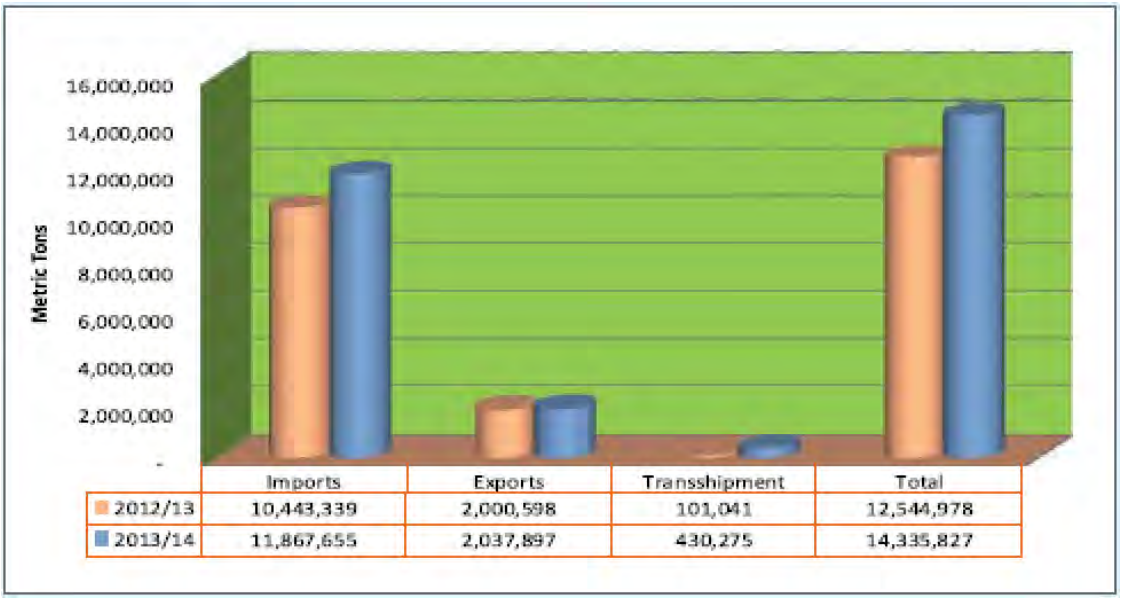
Figure 5.1.41 Port of DSM

1) Cargo Traffic

Regarding cargo traffic, a total of 14.335 million tons were handled at DSM port in 2013/14 as compared to 12.544 million tons handled in 2012/13. This makes an increase of 1.790 million tons in cargo traffic handled which is equal to 14.27%. The total cargo handled comprised of imports, exports and transhipment of 11.867, 2.037 and 0.43 million tons respectively.

The cargo handled by the port recorded an increase in imports and exports as shown in Figure 5.1.42.

Containers traffic handled was 614,555 TEUs as compared to 553,052 TEUs in 2012/13. This is an increase of 61,503 TEUs of 11.1%.



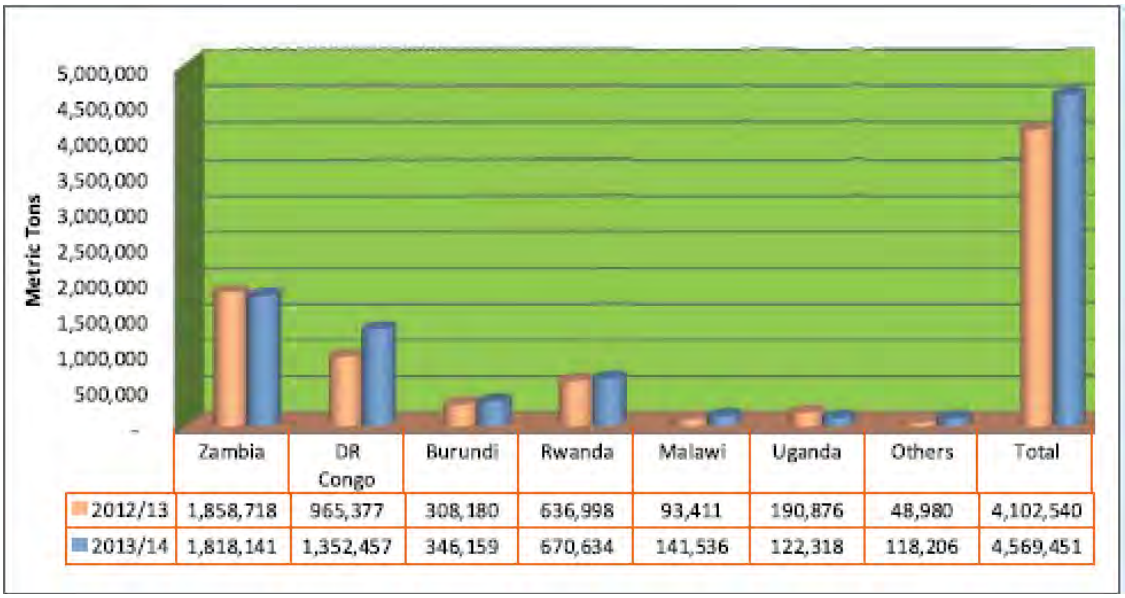
	Imports	Exports	Transshipment	Total
2012/13	10,443,339	2,000,598	101,041	12,544,978
2013/14	11,867,655	2,037,897	430,275	14,335,827

Source: TPA annual report 2014

Figure 5.1.42 Cargo Traffic Volume at DSM Port

2) Transit Traffic

Transit cargo handled at the port was 4,569,451 tons as compared to 4,102,540 tons in 2012/13, which is an increase of 466,911 tons equivalent to 11.4%.



	Zambia	DR Congo	Burundi	Rwanda	Malawi	Uganda	Others	Total
2012/13	1,858,718	965,377	308,180	636,998	93,411	190,876	48,980	4,102,540
2013/14	1,818,141	1,352,457	346,159	670,634	141,536	122,318	118,206	4,569,451

Source: TPA annual report 2014

Figure 5.1.43 Cargo Transit Volume at DSM Port

3) Waterway

Two waterways are operating currently in DSM. One of the waterways is a shuttle service between Kivukoni and Kigamboni. Another one is a middle-distance ferry between DSM and Zanzibar. The details are as follows:

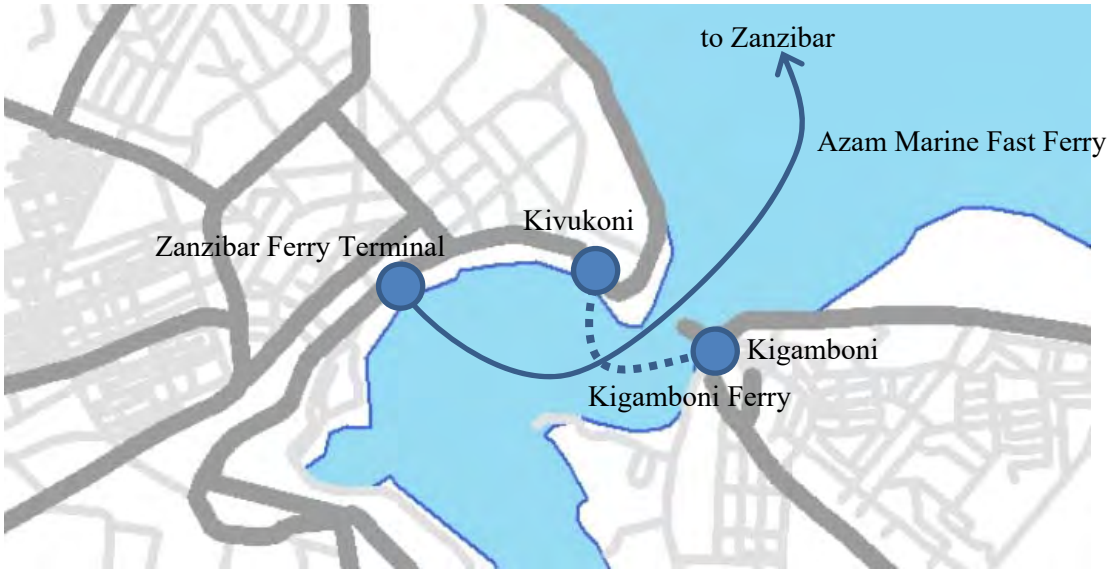


Figure 5.1.44 Current Waterway Service in DSM

a) Kigamboni Ferry

Table 5.1.42 Kigamboni Ferry

Route	Kivukoni – Kigamboni
Distance	0.6km
Time	5-10min (one way)
Frequency	1 round-trip in about 30 minutes (Two vessels ply)

Fare	(TZS)	
	Adults	200
	Child (Below 14 years)	50
	Student	Free
	Bicycles	300
	Baggage more than 50kg	500
	Motorcycles	500
	Carts	1500
	Bajaj	1300
	Saloon Car	1500
	Truck less than 1.5 tons	2000
	Station Wagon	2000
	Mini Bus	3500
	Bus	7500
	Tractor without a trailer	7500

Source: JST

Figure 5.1.45 Boarding at Kivukoni Pier

b) Azam Marine Fast Ferry

Table 5.1.43 Azam Marine Fast Ferry

Route	DSM – Zanzibar
Distance	80km
Time	90 min

Source: JST

Table 5.1.44 Departure Time of DSM and Zanzibar

Daily departures from DSM to Zanzibar	0700HRS / 0930HRS / 1230HRS / 1545HRS
Daily departures from Zanzibar to DSM	0700HRS / 0930HRS / 1230HRS / 1530HRS

Source: HP azam marine

Table 5.1.45 Fare of DSM – Zanzibar

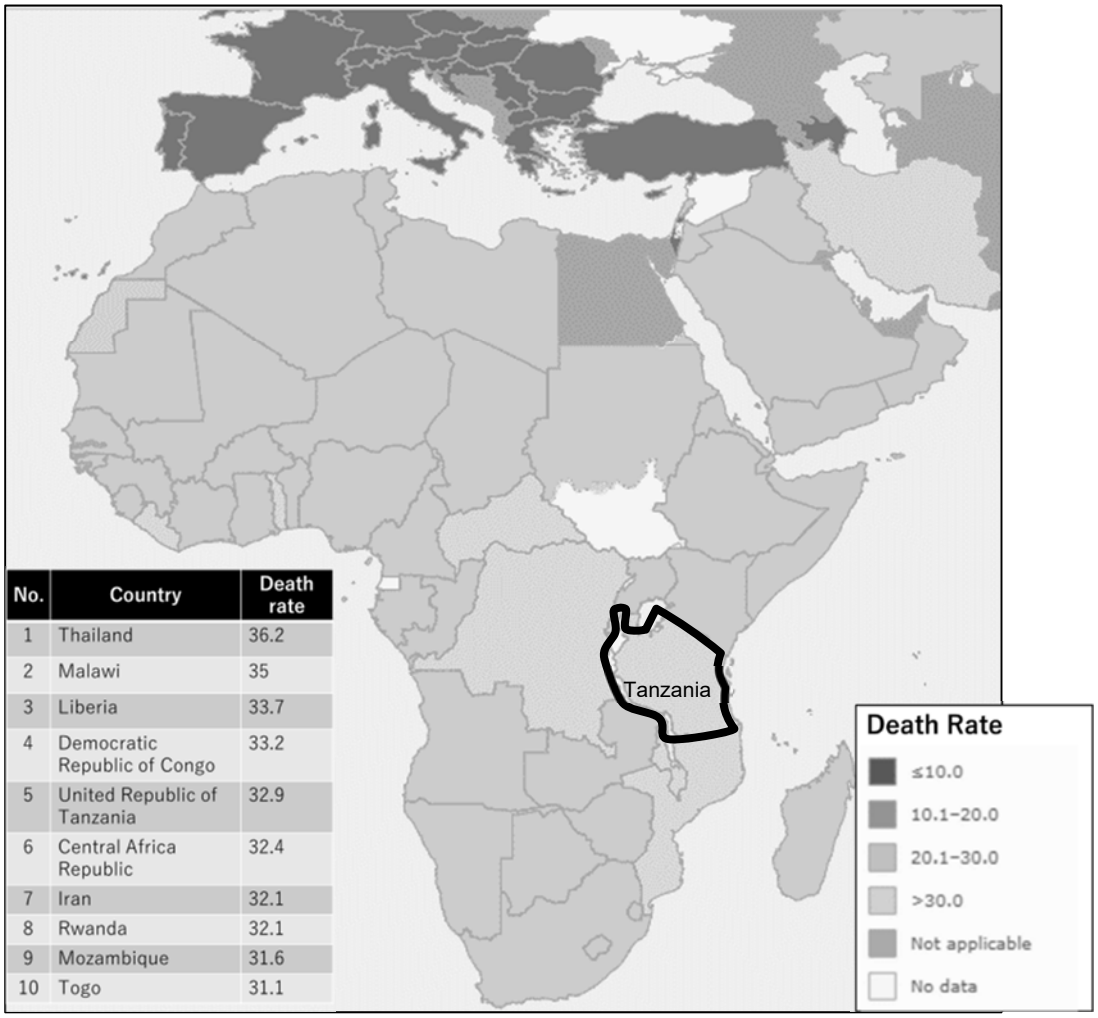
Fare	Category	Economy	Business	VIP	Royal
Residents	Adult (10 Years and Older)	25,000 TZS	35,000 TZS	50,000 TZS	60,000 TZS
	Child (Below 10 Years)	10,000 TZS	35,000 TZS	50,000 TZS	60,000 TZS
Non Residents	Adult (10 Years and Older)	USD 35	USD 40	USD 50	USD 60
	Child (Below 10 Years)	USD 25	USD 40	USD 50	USD 60

Source: HP azammarine

5.1.5 Traffic Safety

(1) Traffic Accident

Traffic accident is one of the major issues in Africa. According to the data from World Health Organization (WHO), Tanzania has high traffic accident death rate, which is ranked 5th in the world and 4th in Africa.



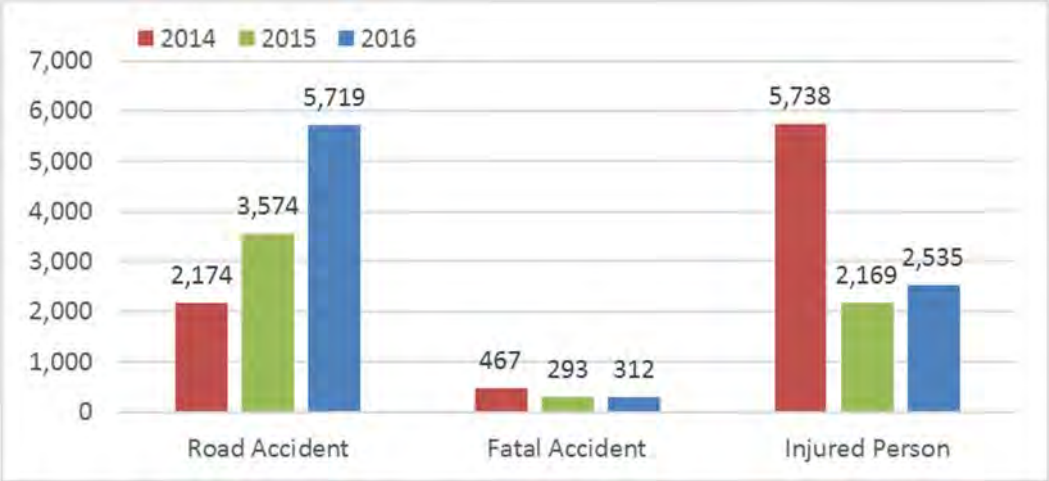
No.	Country	Death rate
1	Thailand	36.2
2	Malawi	35
3	Liberia	33.7
4	Democratic Republic of Congo	33.2
5	United Republic of Tanzania	32.9
6	Central Africa Republic	32.4
7	Iran	32.1
8	Rwanda	32.1
9	Mozambique	31.6
10	Togo	31.1

Source: WHO

Figure 5.1.46 Estimated Road Traffic Death Rate (per 100,000 population), 2013

1) Traffic Accident Statistics

According to the annual crime report, trend of traffic accidents in DSM (DSM) is shown in Figure 5.1.47.



Source: Annual Crime Report

Figure 5.1.47 Number of Traffic Accidents in DSM

Number of accidents in DSM is increasing, but number of fatal accidents and injured persons is decreasing. This means that minor traffic accidents has increased. Vehicle speed in DSM is low because of traffic congestion; therefore, minor accidents might increase in the future.

The major causes of road accidents are the following three groups: human factors, defective motor vehicles, and environmental factors. According to the annual crime report 2016, most major cause is human factor, and careless driving is one of the problems.

Table 5.1.46 Number of Accidents by Main Cause, Tanzania Mainland 2014-2016

	2014		2015		2016	
Causes by Category	Number	Percent	Number	Percent	Number	Percent
Human Factors						
Dangerous Driving	1,896	13.2	1,041	12.5	1,041	10.6
Careless Driving	3,157	22.0	1,827	21.9	2,583	26.2
Careless Cyclists	689	4.8	410	4.9	447	4.5
Careless Motorcyclists	3,163	22.0	2,009	24.1	1,808	18.3
Overspeeding	950	6.6	691	8.3	730	7.4
Careless Passengers	35	0.2	11	0.1	20	0.2
Unattended Livestock	18	0.1	20	0.2	9	0.1
Careless Overtaking	802	5.6	474	5.7	638	6.5
Careless Pedestrians	987	6.9	470	5.6	609	6.2
Careless Pushcart Operators	41	0.3	22	0.3	12	0.1
Intoxication	95	0.7	66	0.8	97	1.0
Sub Total	**11,833**	**82.4**	**7,041**	**84.4**	**7,994**	**81.1**
Defective Motors Vehicles						
Motor Vehicle Defects	990	6.9	502	6.0	755	7.7
Poor Motor Vehicle Lighting	285	2.0	104	1.2	123	1.2
Sub Total	**1,275**	**8.9**	**606**	**7.3**	**878**	**8.9**
Enviromental Factors						
Fire	52	0.4	11	0.1	25	0.3
Road Barriers	489	3.4	341	4.1	533	5.4
Poor Road Infrasturcture	612	4.3	298	3.6	404	4.1
Railway Crossing	99	0.7	40	0.5	22	0.2
Sub Total	**1,252**	**8.7**	**690**	**8.3**	**984**	**10.0**
Grand Total	**14,360**	**100.0**	**8,337**	**100.0**	**9,856**	**100.0**

Source: Annual Crime Report 2016

2) Road Accident Information System (RAIS)

Currently, the Ministry of Works introduced Road Accident Information System (RAIS); this is the system that was installed by World Bank project. As of November 2017, the database was transferred to the Ministry of Home Affairs. However, this system is in its beginning stage, and it has been noted that the system includes a part of traffic accident data of the year 2015 and 2016. This system provides traffic accident information about location, accident type, accident category, date, weather, etc. The Tanzania government will be able to analyse causes of traffic accidents. Summary of traffic accidents is shown in Table 5.1.46, and traffic accident map by accident categories based on this system is shown in the Annex. Main roads such as Morogoro Road, Bagamoyo Road, and Kawawa Road have many traffic accidents, and two intersections across 1) Morogoro road and Kawawa Road and 2) Morogoro road and Nelson Mandela road are black spots.

Table 5.1.47 Summary of Traffic Accident Data on RAIS

Category **	Bagamoyo/A.H.Mwinyi Rd		Morogoro Rd		Julius K. Nyerere Rd		Kawawa/Mwai Kibaki Rd		Nelson Mandela/Sam Nujoma Rd	
	2015	2016*	2015	2016*	2015	2016*	2015	2016*	2015	2016*
CAT 1	12	43	14	33	2	16	13	31	6	17
CAT 2	69	79	25	70	-	27	23	35	23	55
CAT 3	29	38	10	28	-	2	16	27	4	11
CAT 4	26	44	4	19	-	11	5	10	9	21
CAT 5	51	71	23	16	2	40	12	16	17	45
CAT 6	-	2	-	1	-	1	-	1	1	2
CAT 7	33	29	41	45	-	13	10	5	15	31
Total	220	306	117	212	4	110	79	125	75	182

Source: RAIS

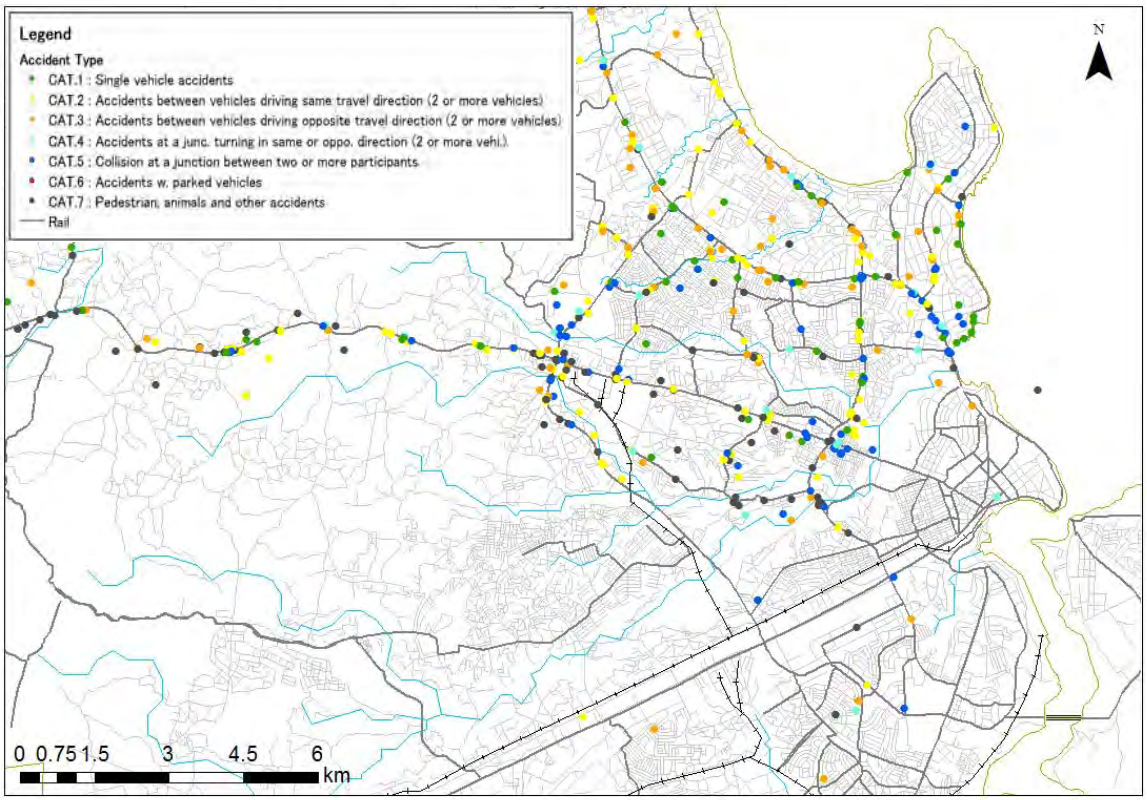
*: January to December 2016

**: Legend of Category is the following;
Source: Ministry of Works, Transportation, and Communication

As mentioned above, the traffic accident data of this system is not yet completed, and it is noted that simple comparison is not appropriate.

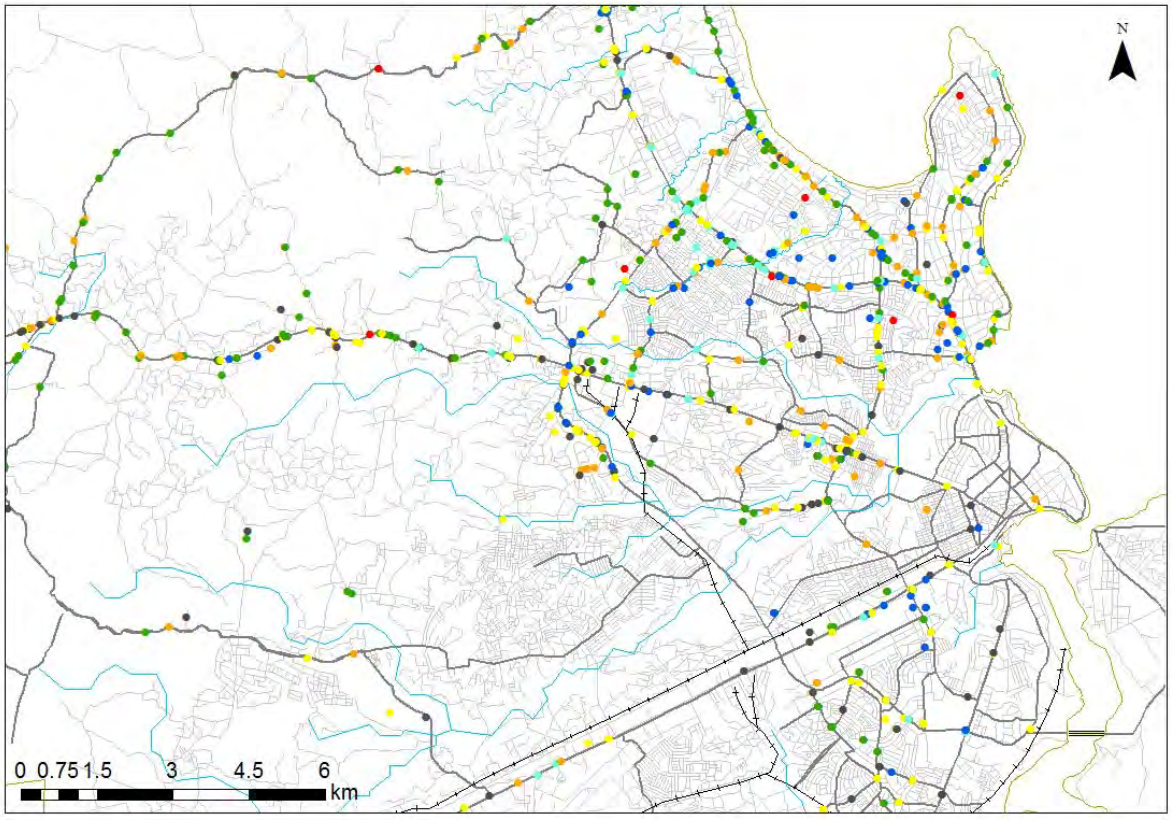
According to this database, the number of traffic accidents on Morogoro Road in 2016 have increased compared to the previous year. On the other hand, the number of traffic accidents on Bagamoyo Road in 2015 has decreased compare to the previous year. BRT was introduced in 2016 along with Morogoro Road. Therefore, it is assumed that a change of traffic situation by introducing BRT affects traffic accidents.

Regarding accident type, CAT.2 and CAT.5 show high numbers. Rear-end collision (accident type 207) is highest in numbers, and it is assumed that over speeding and careless driving are the causes of accidents. Collision driving straight (accident type 507) also show high numbers in 2015 and 2016.



Source: RAIS

Figure 5.1.48 Traffic Accidents by Category, 2015



Source: RAIS

Figure 5.1.49 Traffic Accidents by Category, 2016 (Jan - Nov)

Pedestrians cross the main road that is because there are few pedestrian bridges or underpasses. This is very dangerous behaviour, and it can potentially increase traffic accidents between vehicles and

pedestrians if no actions are taken in advance.

Source: JST

Figure 5.1.50 People Crossing along Main Road

The traffic police is responsible for traffic enforcement and traffic safety education, but they do not plan about traffic management or traffic safety. Traffic safety education and experience of traffic control is useful activity for traffic management. Therefore, the traffic police should be involved in considering future traffic management and its planning.

(2) Intersection

Many traffic accidents occur at intersections; therefore, the intersection shape is related to traffic safety. There are three types of intersection shapes in DSM: cross type, roundabout, and T-type. Major intersections' locations are shown in Figure 5.1.50.

Intersection shape should be simple as to not complicate traffic behaviour, because traffic accidents tend to occur at intersections. The outline of characteristics of intersection shapes is summarized below. It is desirable to identify the traffic situation with these shapes. Therefore, renewal of intersection shape becomes one of the traffic safety measures.

Table 5.1.48 Characteristics of Intersection and Roundabout

Type	Intersection	Roundabout
Image		
Characteristics	・Easy to understand and to pass through for driver ・Need to dedicate lane for right turn or left turn if needed.	・Need to set a rule about how to pass through ・Decrease risk of traffic by decreasing speed ・Need for site acquisition more than intersection construction

Source: JST

(3) Traffic Signal

There are 54 signal intersections in DSM. Traffic signals have been installed along only the national road so far. Actual construction and installation of traffic signals has been conducted by Tanzania Electrical Mechanical and Electronics Service Agency (TEMESA). TEMESA contracts with TANROADS regarding installation and maintenance of the traffic signal. There is no traffic control

centre in DSM.

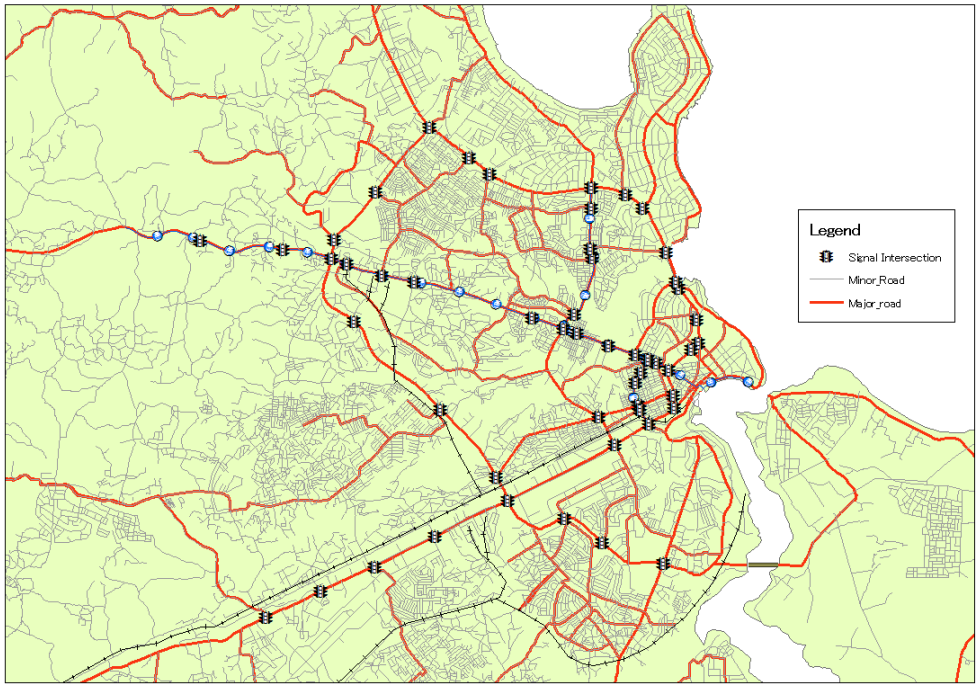
The signal cycle of these traffic signals is fixed. Although they have a function for changing the cycle, the signal cycle is not to be changed according to traffic situation such as peak time, weekday and holiday, etc. One issue is that traffic signals are old, and some traffic signal controllers cannot be fixed because there are no replacement parts.

Another issue is that the traffic police have controlled vehicle traffic at the congested intersections. Traffic movement should be harmonised for area traffic management, and individual control by manual traffic signal is difficult to do. Therefore, introducing adapted traffic signals and traffic control centres is very important for improvement of traffic management.

Source: JST

Figure 5.1.51 Traffic Control by Traffic Police

TANROADS have a plan for additional installation of traffic signals in DSM; it is assumed that traffic signals will be installed for managing traffic movement in the city. Current location of signal intersection is shown in Figure 5.1.52, and a list of the basic information of traffic signals is shown in the Annex.



Source: JST based on the list provided by TEMESA

Figure 5.1.52 Location of Traffic Signal

(4) Parking

DSM City Council has the responsibility to manage on-road parking. Some building owners or companies have installed and operated parking lots in the buildings or road side of buildings.

The City Council also has the responsibility of setting parking fees. Previous parking fee is 300 TZS/hour for CBD and 100 TZS/hour for KBD, Kinondoni and Temeke, but the current fee was raised to 500 TZS/hour on December 2016. This fee is the flat rate for all municipalities.

On-road parking is one of the issues for traffic management. Since these cars sometimes block the side walk, pedestrians cannot walk along them. This situation increases traffic accidents. In addition, illegal parking decreases road capacity, and it becomes a cause of traffic congestion. In the current traffic situation, many vehicles concentrate on the CBD area, and the CBD area does not have enough space for parking. Therefore, it is necessary to avoid parking in the CBD area and to provide parking space around the CBD area for shifting transportation modes such as the Park & Ride system. There are no or few parking spaces for private vehicles at BRT stations/Bus terminals. Some stations/terminals have mode exchange point for taxi / bodaboda pool.

Source: JST

Figure 5.1.53 Parking Situation in DSM

Source: JST

Figure 5.1.54 Taxi and Bodaboda Pool along with BRT Route

5.2 Traffic Demand

5.2.1 Traffic Survey

(1) Contents of Traffic Survey

1) Objective

The major objectives of the traffic surveys are as follows:

- To update the result of the previous survey, and evaluate the variation of traffic movement;
- To analyse the effect of the transport infrastructure development after 2008;
- To formulate the database for the traffic forecast in 2040.

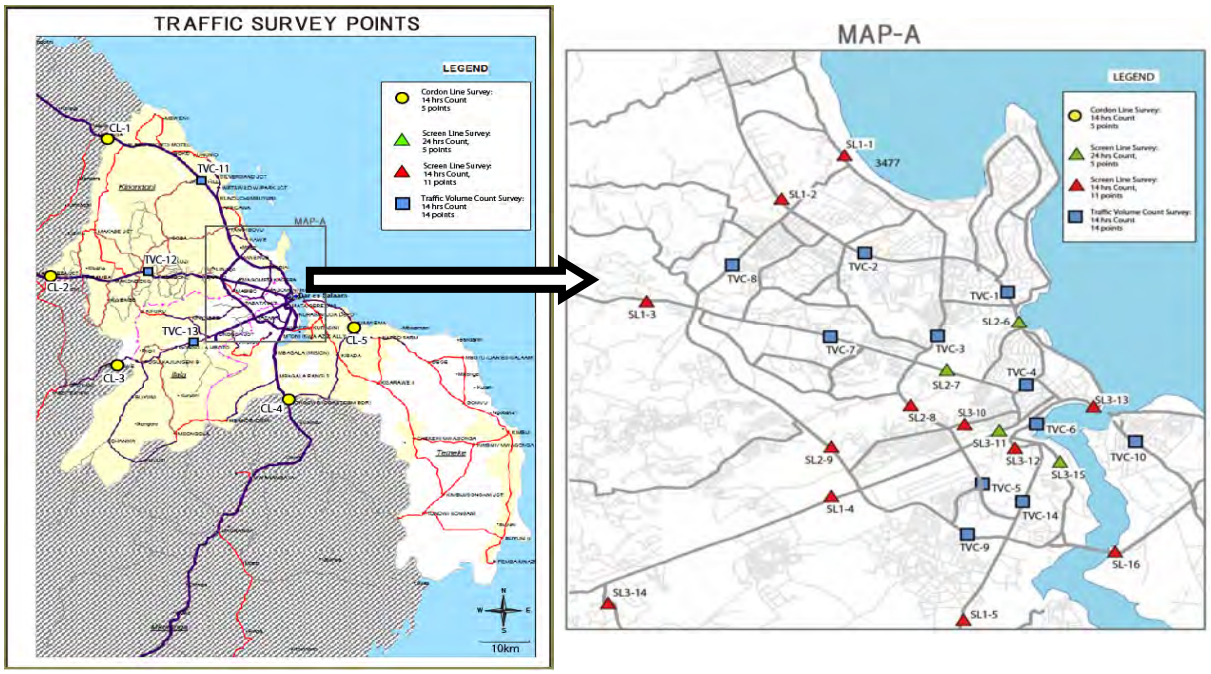
2) Outline of the Traffic Surveys

Ten types of traffic surveys were conducted as shown in Table 5.2.1. Survey types and survey methods were selected consistency with the 2008 Master Plan surveys.

Table 5.2.1 Summary of Traffic Survey

	Study item	Contents	Target	Field Work
1	Cordon Line Survey	To capture the traffic volume from inside and outside of the city, Origin-Destination, Trip Purpose, Contents of Commodity etc.	7 points (14 hrs counts & OD Survey)	Jan-Feb /2017
2	Screen line Survey	To confirm accuracy of person trip survey by counting the number of vehicles crossing main screen lines	16 points in total 11 (14 hrs count) + 5 (24 hrs count)	Jan-Feb /2017
3	Traffic Volume Count Survey	To capture traffic movement on weekdays by counting the number of vehicles on main roads	14 points (14 hrs count on weekday)	Jan-Feb /2017
4	Travel speed survey	To analyse travel speed by bus and passenger vehicles affected by traffic congestion on the radial and ring roads during peak hours	12 routes, at 3peak-hours (mooring, noon and evening)	Feb/2017
5	Roadside Parking Survey	To measure roadside parking density in CBD area (three peak hours (morning, afternoon, evening) on weekdays	10 roads	Jan-Feb/2017
6	Person-Trip Survey (PT Survey)	To collect Household information, Household member information and household member trip information: Gender, Age, Household composition, Occupation, No. of own Vehicles, Trip purpose and transport mode, Transport Cost, Travel Time, etc.	22,000 households (88,000 samples)	Feb-Mar/2017
7	Freight Traffic Survey	To interview survey mainly of cargo drivers by logistics freight company	Approx. 50 companies	Feb-Mar/2017
8	Public Transport User Survey	To interview bus and ferry users	Approx. 200 samples	Feb-Mar/2017
9	Road User Survey	To understand current problems and issues by the interview survey to road users	Approx. 200 samples	Feb-Mar/2017
10	Stated Preference/ / Revealed Preference Survey (SP/RP Survey)	RP Survey: To ask the reason for the selection of existing transport mode (BRT, Rail), SP Survey: To ask the selection of transport mode including future transport mode, request to improve, willingness-to-pay	500 users by BRT 500 users by Rail	Feb-Mar/2017

Source: JST



Source: JST

Figure 5.2.1 Location of Traffic Survey

3) Cordon Line Survey

a) General

Cordon Line survey, mostly conducted along the boundary of the Study area, consists of several elements:

- A traffic counts;
- A road-side interview survey to the sample drivers questioning trip origin-destination, and purpose;
- Count and interview to the passengers at the Nyerere (DSM) International Airport. The interview was conducted at the boarding (departure) direction of the domestic and international section at the airport. Questioning trip origin-destination, and purpose;
- Count and interview to the passengers at the Zanzibar/Pemba Ferry Terminal. The interview was conducted at the boarding (departure) direction, questioning trip origin- destination, and purpose.

b) Survey Locations

Cordon Line Survey locations are shown in Table 5.2.2 and Figure 5.2.2.

Table 5.2.2 List of Cordon Line Survey Points

Survey Points		Survey Hours (One weekday)			Survey Date
No.	Location Name	Traffic Count	Interview	Passenger Count	
CL-1	Bagamoyo Road	14	14	-	Feb.02, 2017(Thu)
CL-2	Morogoro Road	14	14	-	Feb.02, 2017(Thu)
CL-3	Nyerere Road	14	14	-	Feb.02, 2017(Thu)
CL-4	Kilwa Road	14	14	-	Feb.02, 2017(Thu)
CL-5	Mjimwema Road	14	14	-	Feb.02, 2017(Thu)
CL-6	Nyerere International Airport	(counted by Screen line survey)	14	14	Feb.07, 2017(Tue)
CL-7	Zanzibar/Pemba Ferry Terminal	(counted by Screen line survey)	14	14	Feb. 07, 2017(Tue)

Source: JST

Source: JST

Figure 5.2.2 Cordon Line Survey Locations

4) Screen Line Survey

a) General

Screen line survey is to obtain the traffic volume, by counting the number of vehicles at several locations along imaginary lines (screen lines). For this survey, screen lines are divided into parts. Screen line survey is for evaluating traffic congestion at each location, and for calibrating the current trip origin-destination information surveyed by interviewing to the household.

b) Survey Location

Screen line survey was conducted at the 16 locations, including river and railway crossings, access road to Julius Nyerere International Airport (JNIA) , and the sea port of DSM.

Table 5.2.3 List of Screen Line Survey Roads

No.	Survey Points	Survey hours	Survey Date
SL1-1	Old Bagamoyo Road	14hrs (06:00-20:00),	Jan.17, 2017 (Tue)
SL1-2	Bagamoyo Road	14hrs (06:00-20:00), one weekday	Jan.17, 2017 (Tue)
SL1-3	Morogoro Road	14hrs (06:00-20:00), one weekday	Jan.17, 2017 (Tue)
SL1-4	Nyerere Road	14hrs (06:00-20:00), one weekday	Jan.18, 2017 (Wed)
SL1-5	Kilwa Road	14hrs (06:00-20:00), one weekday	Jan.19, 2017 (Thu)
SL2-6	Ali Hassan Mwinyi Road	24hrs (06:00-06:00 next day), one weekday	Jan.19, 2017 (Thu)
SL2-7	Morogoro Road	24hrs (06:00-06:00 next day), one weekday	Jan.17, 2017 (Tue)
SL2-8	Rashid Kawawa Road	14hrs (06:00-20:00), one weekday	Jan.17, 2017 (Tue)
SL2-9	Nelson Mandela Road	14hrs (06:00-20:00), one weekday	Jan.18, 2017 (Wed)
SL3-10	Uhuru Street	14hrs (06:00-20:00), one weekday	Jan.18, 2017 (Wed)
SL3-11	Nyerere Road	24hrs (06:00-06:00 next day), one weekday	Jan.18, 2017 (Wed)
SL3-12	Bandari Road	14hrs (06:00-20:00), one weekday	Jan.18, 2017 (Wed)
SL3-13	Kigamboni Ferry Terminal	14hrs (06:00-20:00), one weekday	Jan.19, 2017 (Thu)
SL-14	Nyerere (DSM) Intl. Airport	All counts for 24 hours	Feb. 07, 2017(Tue)
SL-15	Seaport of DSM	All counts for 24 hours	Feb. 07, 2017(Tue)
SL-16	Mwalimu Nyerere Bridge (Kigamboni Bridge)	14hrs (06:00-20:00), one weekday	Jan.19, 2017 (Thu)

Source: JST

Source: JST

Figure 5.2.3 Screen Line Survey Locations

5) Traffic Volume Count Survey

a) General

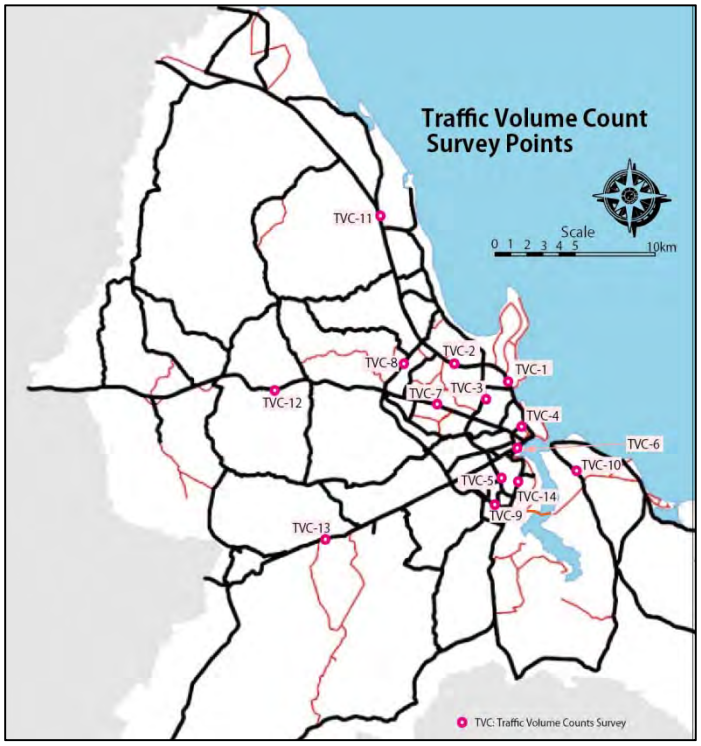
Traffic volume count survey is to count the number of vehicles at several locations on the main trunk roads. Traffic volume is collected for evaluating traffic congestion at each location, and for calibrating the current trip origin-destination information surveyed by interviewing to the household.

b) Survey Location

It was conducted at the 14 locations at major roads as described in Table 5.2.4 and illustrated in Figure 5.2.4.

Table 5.2.4 List of Traffic Count Survey Roads

No.	Survey Points	Survey hours	Survey Date
TVC-1	New Bagamoyo Road (before Haile Selassie Road Junction)	14hrs (06:00-20:00)	Jan.24, 2017 (Tue)
TVC-2	New Bagamoyo Road (after Kawawa Junction)	14hrs (06:00-20:00)	Jan.24, 2017 (Tue)
TVC-3	Kawawa Road (between New Bagamoyo Rd. and Morogoro Rd.)	14hrs (06:00-20:00)	Jan.24, 2017 (Tue)
TVC-4	Bibi Titi Mohamed Road	14hrs (06:00-20:00)	Jan.24, 2017 (Tue)
TVC-5	Chang'ombe Road	14hrs (06:00-20:00)	Jan.25, 2017 (Wed)
TVC-6	Sokoine Drive	14hrs (06:00-20:00)	Jan.25, 2017 (Wed)
TVC-7	Morogoro Road (Manzese)	14hrs (06:00-20:00)	Jan.25, 2017 (Wed)
TVC-8	Sam Nujoma Road	14hrs (06:00-20:00)	Jan.25, 2017 (Wed)
TVC-9	Nelson Mandela Road	14hrs (06:00-20:00)	Jan.25, 2017 (Wed)
TVC-10	Kigamboni	14hrs (06:00-20:00)	Jan.24, 2017 (Tue)
TVC-11	New Bagamoyo Road (Tegeta)	14hrs (06:00-20:00)	Jan.25, 2017 (Wed)
TVC-12	Morogoro Road (Mbezi)	14hrs (06:00-20:00)	Jan.25, 2017 (Wed)
TVC-13	Nyerere Road (after airport)	14hrs (06:00-20:00)	Jan.25, 2017 (Wed)
TVC-14	Kilwa Road (before Nelson Mandela Junction)	14hrs (06:00-20:00)	Jan.24, 2017 (Tue)



Source: JST

Figure 5.2.4Traffic Volume Counts Survey Locations

6) Travel Speed Survey

a) General

Travel speed survey was carried out on February 07, 2017(Tue) , in order to (i) obtain the travel speed data on the major corridors within the study area, (ii) identify the bottlenecks on the major corridors, and, (iii) assess the existing traffic condition.

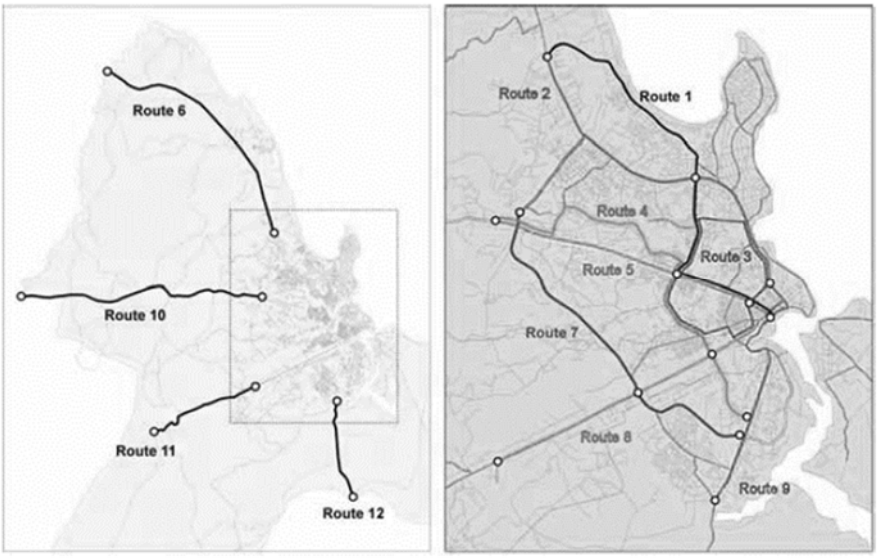
b) Survey Routes

Survey routes are listed in Table 5.2.5 and Figure 5.2.5.

Table 5.2.5 Travel Speed Survey Route

No	Start of Route	Route	End of Route
1	Bagamoyo Rd.– Old Bamoyo Rd. intersection	Old Bagamoyo Rd. – Rashid Kawawa Rd.– Morogoro Rd.	DSM City Hall
2	Bagamoyo Rd.– Old Bamoyo Rd. intersection	Bagamoyo Rd. – Ali Hassan Mwinyi Rd.– Ohio St. – Sokoine Drive (Samora St.)	DSM City Hall
3	Bibi Titi Mohamed St. – Morogoro Rd. intersection	Bibi Titi Mohamed St. – Nyerere Rd. – Msimbazi St.- Uhuru St. – Rashid Kawawa Rd. – Kinondoni Rd. – Ali Hassan Mwinyijuma Rd.–Bibi Titi Mohamed St.	Bibi Titi Mohamed St. –Morogoro Rd. intersection
4	Morogoro Rd. (Ubungo bus terminal)	Morogoro Rd. – Shekilango St. MwinyjumaSt. – Rashid Kawawa Rd. -	Kilwa Rd. – Rashid Kawawa Rd. intersection
5	Morogoro Rd. (Ubungo bus terminal)	Morogoro Rd.	DSM City Hall
6	Bagamoyo Rd. (Border od DCC)	Bagamoyo Rd.	Bagamoyo Rd. – Old Baamoyo Rd. intersection
7	Sam Nujoma Rd. (DSM Univ.)	Sam Nujoma Rd. – Nelson Mandela Rd.	Nelson Mandela Rd. (Kurasini)
8	Nyerere Rd. (DSM International Airport) -Nyerere Rd. – Nkrumah St. – Samora Ave.	Nyerere Rd. – Nkrumah St. – Samora Ave.– Morogoro Rd.	DSM City Hall
9	Kilwa Rd.– Kichangani St. intersection	Kilwa Rd. – Bandari Rd. – Gerezani St. – Sokoine Drive – Railway St. – Samora Ave.	DSM City Hall
10	Morogoro Rd. (Border of DCC)	Morogoro Rd.	DSM City Hall
11	Pugu Rd. (Border of DCC)	Pugu Rd.	DSM International Airport
12	Kilwa Rd. (Border of DCC)	Kilwa Rd.	Kilwa Rd.– Kichangani St. intersection

Source: JST



Source: JST

Figure 5.2.5 Travel Speed Survey Routes

c) Survey Hours

The survey was conducted with three round trips during the peak hours in the morning (06:00-09:00), noon (11:00-14:00) and evening (16:00-19:00).

7) Roadside Parking Survey

a) General

Roadside Parking Survey was conducted at the CBD (around 5km in total: 500m Road length x 10) sections, where roadside parking was visible.

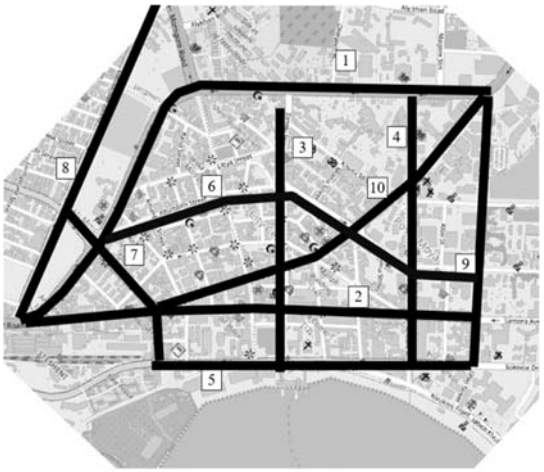
b) Survey Locations

Survey location is shown in Figure 5.2.6.

Table 5.2.6 Survey Roads for Roadside Parking Survey

No.	Objective Roads
1	Bibi Titit Mohamed Road
2	Samora Avenue
3	Zanaki Street
4	Azikiwe Road
5	Sokoine Drive
6	Jamhuri Street
7	Uhuru Street
8	Lumumba Street
9	Ohio Street
10	India Street

Source: JST



Source: JST

Figure 5.2.6 Location Map for Roadside Parking Survey

c) Survey Hours

The survey hour extended to six hours; two hours during the morning peak period (07:00-09:00), two hours during lunch time peak period (12:00-14:00) and two hours during the afternoon peak period (16:00-18:00).

8) Household Interview Survey (HIS)

a) Objective of the Household Interview Survey

The principal objective of the HIS is to collect comprehensive information of the travel pattern and characteristics of the residents in the Study area. The survey also tried to collect socio-economic characteristics of the sample households and individual household members, which might contribute to the trip information.

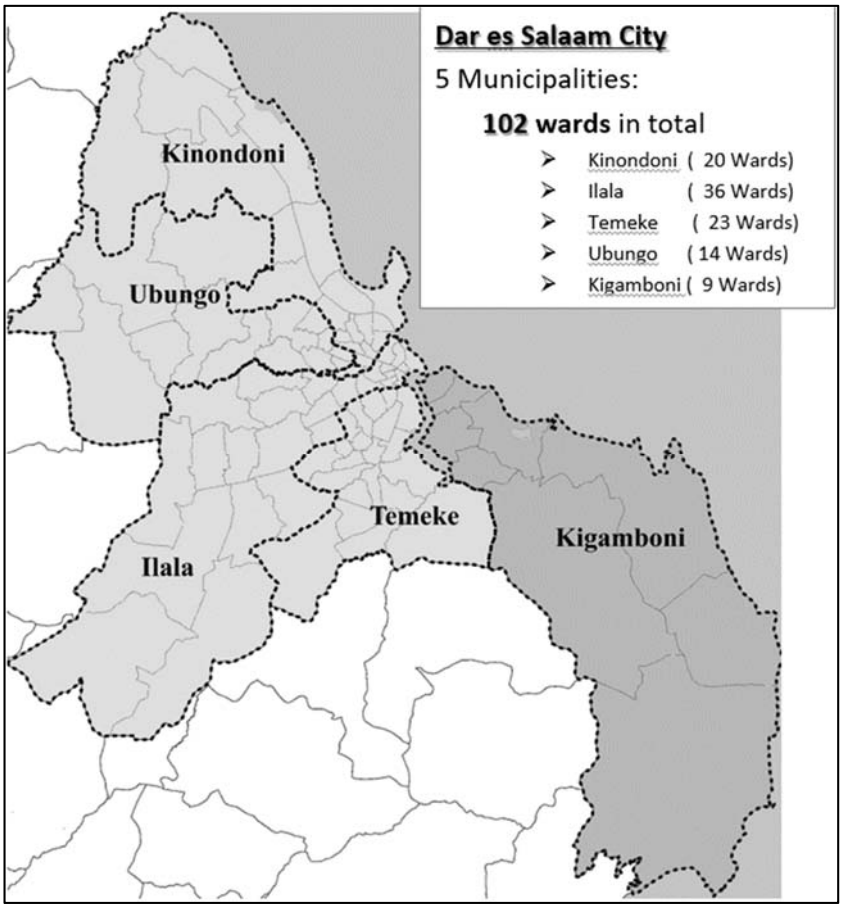
The information included to the interview was:

- Household demographic information;
- Household economic conditions (household monthly income, number of vehicles owned, etc.);
- Individual attributes (social status, income, etc.) of each household members;
- Trip information of each household member.

b) Survey Area

Figure 5.2.7 shows the survey area. JST set the target of the HIS survey area covers all the Municipal

Councils of Ilala, Kinondoni, Temeke, Ubungo and Kigamboni. The population of the Study area is estimated at about 4.36 million in 2012, and the total number of households is estimated at 1.0 million. Zone Maps are shown in Annex.



Source: JST

Figure 5.2.7 Survey Area for Household Interview Survey

c) Number of Samples

Target ratio of the sampling is 2%. Number of samples are 88,000 which is the number of 22,000 households. According to the Population Census in 2012, average number of household members in DSM was 4.0.

d) Interview Items

JST prepared the survey forms in English. The interview itself was translated into Swahili. The survey form includes the following three items:

- Household Information (Form-1)
- Household Member Information (Form-2)
- Household Member Trip Information (Form-3)

Detailed interview items for each item is:

- Household Information (Form-1)
  - Resident address
  - Number of household members
  - Number of vehicles of the household by type (vehicle ownership)
- Household Member Information (Form-2)

  - Gender, Age
  - Driving license
  - Occupation category by economic activity (types of job, school, etc.)
  - Individual monthly income
  - Address (and/or landmark, building name) of working or school place
  - Number of trips on the survey day
- Household Member Trip Information (Form-3)
  - Origin / Destination (address, landmark, building name, etc)
  - Departure/Arrival time
  - Trip purpose
  - Transport modes during the trip, access/egress time, waiting time, travel time

9) Cargo Transport Survey

a) General

Cargo transport survey was conducted at the major companies providing trucking services for cargo, or at locations where activity by large trucks were crowded. There are two survey elements, namely (i) interview to the management staff, and (ii) interview to the drivers to obtain information on trip (cargo pick-up/drop-off) patterns. Survey was also conducted to the truck drivers at the (sea) Port of DSM.

b) Survey Area

The survey area covered the whole DSM Area. Realistically JST focused on the location where trucking companies accumulated.

c) Survey Contents

Cargo transport survey consists of company profiles, including basic information, major handling cargo information, and trip information of truck drivers.

10) Public Transport Passenger Interview Survey

a) General

Public Transport Passenger Interview Survey aimed to grasp the personal attributes of the bus and ferry passengers. It also intended to get the awareness or impression of the current bus and ferry services. Through analysis of survey, the needs of the users were identified, and it contributes to improve the current bus service and network.

b) Survey Location

Survey was conducted at the seven major bus terminals in DSM; Mwenge, Ubungo, Mbagala, Kigamboni Ferry, Kariakoo, Posta and Tandika. The locations of the terminal are shown in Figure 5.2.8.

Source: JST

Figure 5.2.8 Bus Terminal Location

c) Survey Date and Hours

Survey was carried out on weekdays from Tuesday to Thursday, except for the public holidays.The survey hours extended over six hours; three hours during the morning peak period (06:00-09:00) and three hours during the afternoon peak period (16:00-19:00).

d) Sampling Numbers

Number of sampling was at least 200 samples at bus and ferry terminals.

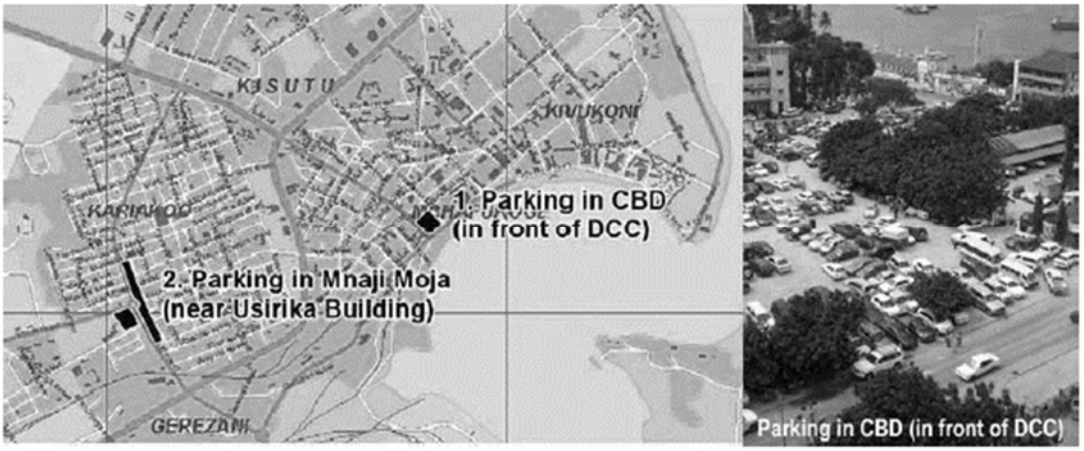
11) Car User Interview Survey

a) General

The Car User Interview Survey was to grasp car users' attitudinal perception of the current bus service. It also aims to get the preference for use of the car.

b) Survey Locations

Location of the survey was at two off-street parking spaces in the CBD area shown in Figure 5.2.9; one in front of the DCC, and the other at Mnazi Mmoja (near the Ushirika Building). Most parking spaces in both the CBD and Mnazi Mmoja were reserved for the employees nearby the office buildings.



Source: JST

Figure 5.2.9 Locations of Car User Interview Survey

c) Survey Date and Hours

Survey was conducted on weekdays, except for the public holidays and weekends. The survey hour was over six hours; two hours during the morning peak period (07:00-09:00), two hours during lunch time peak period (12:00-14:00) and two hours during the afternoon peak period (16:00-18:00).

d) Sampling

Sampling was collected at least 200 car users, approximately 15 car users per day per surveyor.

12) Stated Preference (S/P) and Revealed Preference (R/P) Survey

a) General

S/P and R/P Survey aim to get the attitudinal perception of BRT and Railway users', the current bus service including BRT, the revealed preference for use current bus service, and the stated preference for use of the new urban transport service – MRT or LRT instead of Bus Rapid Transit (BRT).

b) Survey Locations

BRT User Interview Survey for S/P and R/P survey was carried out at the BRT stations, while Railway User Interview Survey was at TAZARA Railway DSM Station.

c) Survey Date and Hours

Survey was conducted on weekdays, excluding public holidays. Total hours of the survey per day was six hours; three hours during the morning peak period (06:00-09:00), three hours during the afternoon peak period (16:00-19:00).

d) Sampling

Sampling for BRT users was at least 500, and also 500 railway users.

e) Survey Method

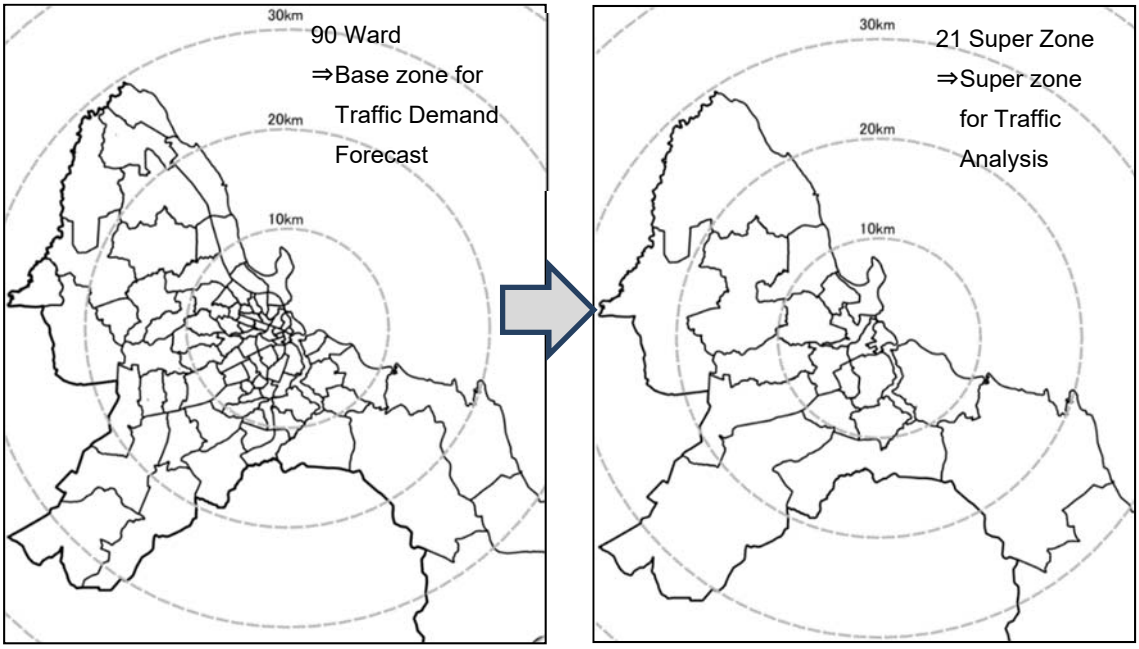
Surveyors randomly interviewed the car users, BRT users and railway users at the stations. Information collected through the interview includes:

- Stated preference for future public transport (Mass transit, BRT for next phase project, other transport mode, etc.)
- Revealed preference for existing BRT

5.2.2 Person's Movement

(1) Summary of Person Movement

Survey and transport demand forecast were conducted by unit of ward. In this section, JST figured out the real characteristics and macro traffic distribution based on 21 super zones.



Source: JST

Figure 5.2.10 Zoning Map

(2) Public Transport User and Car User Interview Surveys

1) Number of Samples

Car user interview survey and Public transport user survey were conducted including Stated-Preference Survey (S/P) and Revealed-Preference Survey (R/P) by sub-consultant. The number of samples is shown below.

Table 5.2.7 Number of Samples for Other Interview Surveys

	Number of Samples Interviewed	Number of Samples (Target)
Daladala User Interview Survey	504	500
Railway User Interview Survey	515	500
BRT User Interview Survey	507	500
Ferry User Interview Survey	204	200
Car User Interview Survey	515	500
Total	2,245	2,200

Source: JST

Table 5.2.8 Interviewee's Occupation

	1	2	3	4	5	6	7	8	9	10	
Occupation	Farmers, Livestock, Fisheries	Workers for Manufacturing Industry	Wholesalers, Retail sellers, Service & Shop workers	Other workers at office	Construction Operators, Workers	Transporters	Other working	Unemployed	Student	Home maker/Housewife/ Retired, Pensioner/ Unable to work	Total
BRT User Interview	12	9	136	103	43	10	57	18	88	31	507
Railway User Interview	11	9	83	143	55	9	105	13	74	13	515
Daladala User Interview	5	25	146	67	31	21	25	44	77	63	504
Car User Interview	3	32	151	258	20	39	11	1	0	0	515
Ferry User Interview	2	3	49	76	4	10	11	3	37	9	204

Source: Results of Interview Survey, JST

Table 5.2.9 Interviewee's Monthly Income

	0	1	2	3	4	5	6	7	
Monthly Income (Tshs/month)	No Income (NONE)	Less than 100,000	100,001-1000,000	1,000,001-2000,000	2,000,001-5,000,000	5,000,001-10,000,000	10,000,001-15,000,000	More than 15,000,001	Total
BRT User Interview	91	5	160	216	34	1	0	0	507
Railway User Interview	80	8	250	168	8	1	0	0	515
Daladala User Interview	172	47	268	15	1	1	0	0	504
Car User Interview	1	10	290	51	28	91	35	9	515
Ferry User Interview	32	18	104	47	3	0	0	0	204

Source: Results of Interview Survey, JST

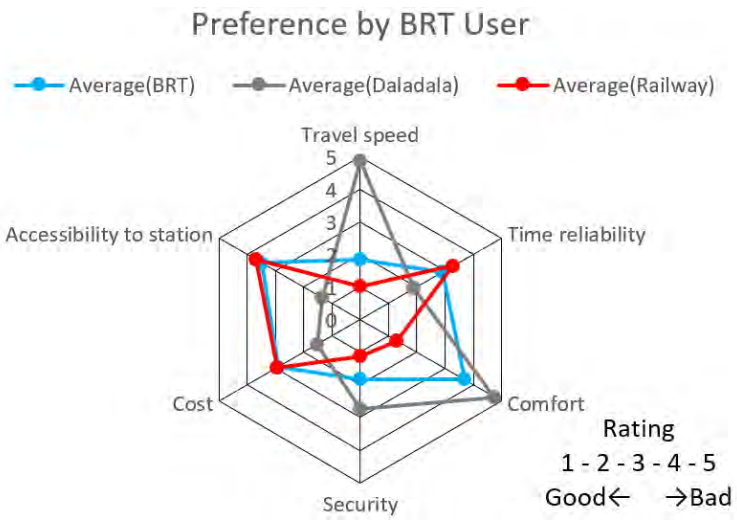
Table 5.2.10 Ownership of Vehicles and Driver Licence

	Gender		Ownership of driver's license		Ownership of vehicles	
	Male	Female	Yes	No	Yes	No
BRT User Interview	333	174	107	400	132	375
Railway User Interview	326	189	90	425	59	456
Daladala User Interview	312	192	65	439	31	473
Car User Interview	466	49	505	10	346	169
Ferry User Interview	143	61	99	105	89	115

Source: Results of Interview Survey, JST

2) Preference by BRT Users

High-ranked preferences have been marked for BRT by BRT users in "Travel Speed", "Security", and "Time Reliability". Approximately 80% of BRT users answered "Cost is Fair". Around 60% of BRT users answered "Accessibility to BRT station is somewhat convenient or inconvenient". Majority of BRT users answered that Daladala is slow and uncomfortable; however, the cost is reasonable, accessibility is convenient. Most of BRT users ranked railway as the fast transport, comfortable and secure. However, time reliability is somewhat low.

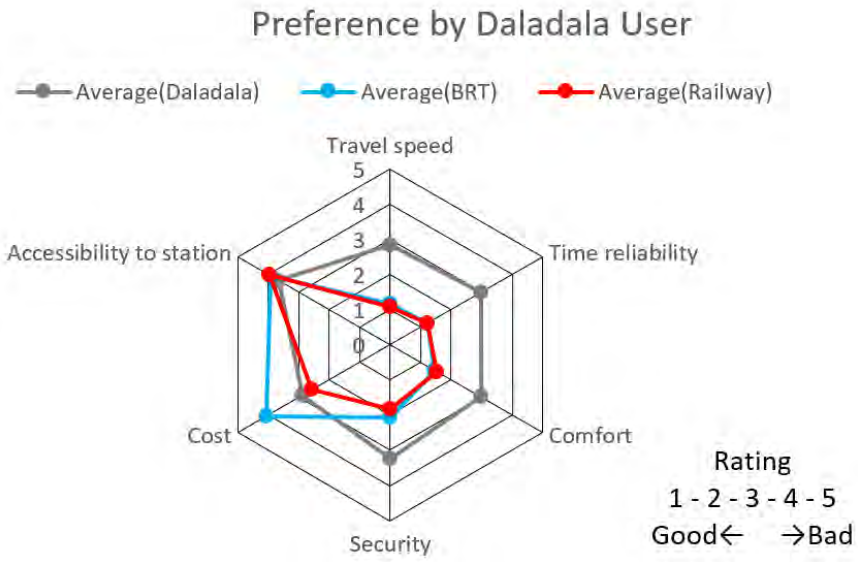


Source: Results of Interview Survey, JST

Figure 5.2.11 Preference for Daladala & Railway by BRT Users

3) Preference by Daladala Users

Daladala users evaluated the level of Daladala services, and said travel speed and cost are fair. When comparing Daladala with BRT, however, many Daladala users answered that BRT is rather fast, stable, comfortable and safe. The factors affecting the level of satisfaction of Daladala are the cost and accessibility to the station. Daladala users answered that railway is fast, stable, safe and cost is fair, but accessibility to the station is inconvenient.

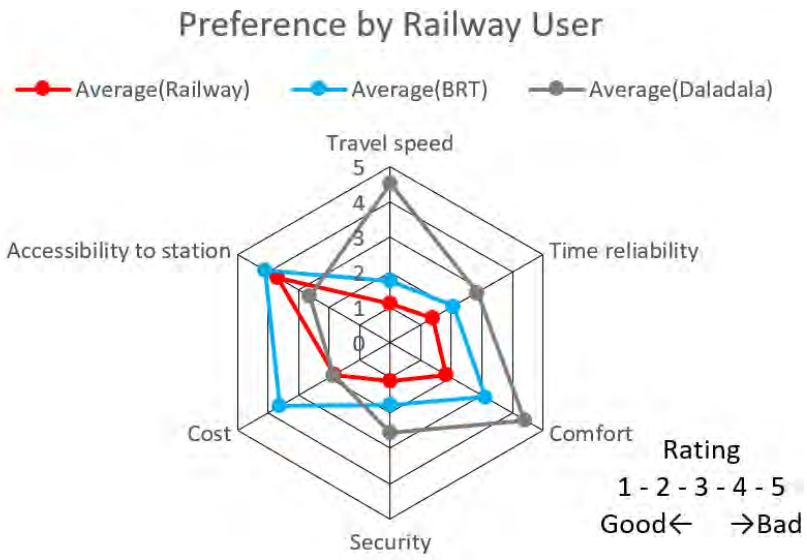


Source: Results of Interview Survey, JST

Figure 5.2.12 Preference for Daladala by Daladala Users

4) Preference by Railway Users

Most of Railway users answered that railway operations are fast, stable, comfortable and reasonable but accessibility to the station is inconvenient. Comparing railway to BRT, the railway users valued BRT more for somewhat fast, stable, comfortable and safe. However, the cost of BRT is expensive and accessibility to the station is inconvenient. Railway users answered that Daladala is slow, uncomfortable, but cost is fair.

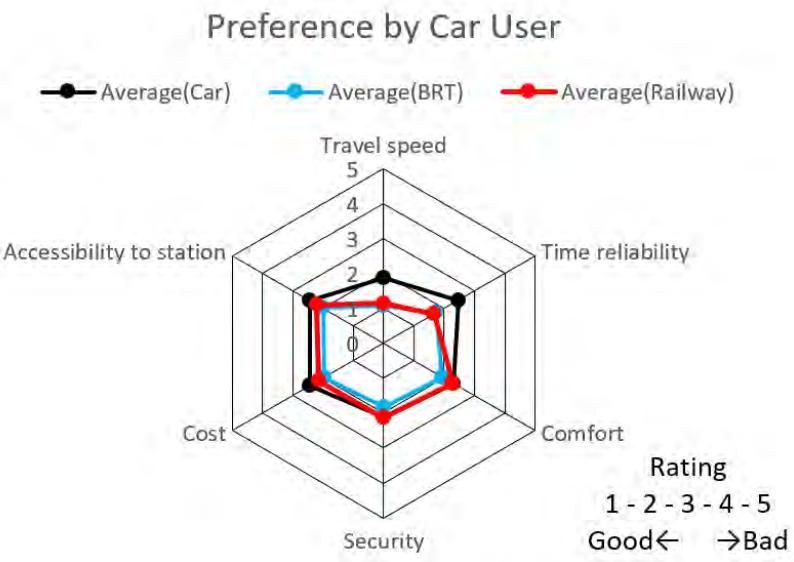


Source: Results of Interview Survey, JST

Figure 5.2.13 Preference for Railway by Railway Users

5) Preference by Car Users

Car users preferred to use the car in terms of its travel speed. Other evaluation items such as "Time reliability", "Cost", "Comfort", "Security", and "Accessibility" are fair. Most car users also evaluated BRT and railway for their operation's speed. According to the results of the interviews, "Time Reliability", "Comfort", "Security", "Cost" and "Accessibility to Station" of BRT and railway are fair.

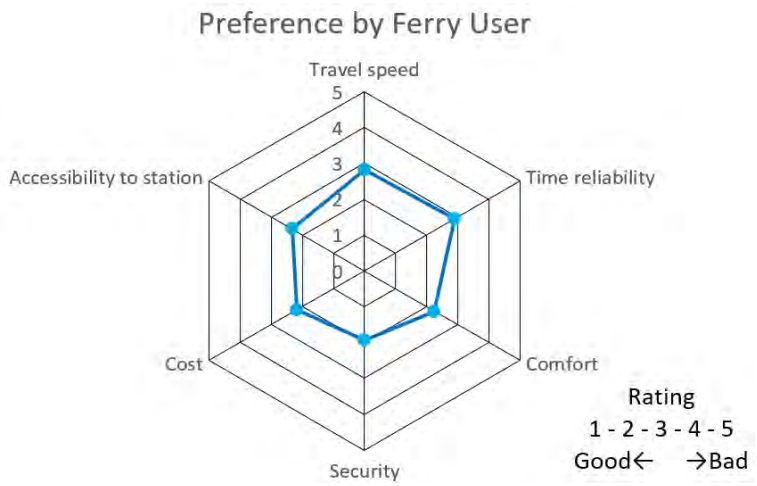


Source: Results of Interview Survey, JST

Figure 5.2.14 Preference for Car by Car Users

6) Preference by Ferry Users

Ferry users evaluated "Comfort", "Security", "Cost" and "Accessibility to other station".



Source: Results of Interview Survey, JST

Figure 5.2.15 Preference for Ferry by Ferry Users

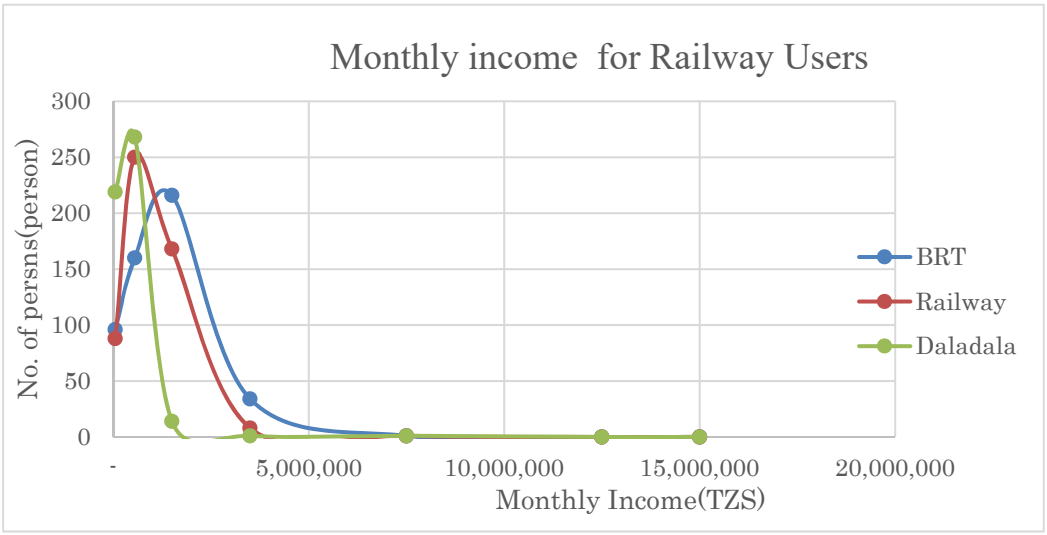
7) Results of Preference to Daladala, BRT and Railway

a) Monthly Incomes of Daladala, BRT and Railway Users

Comparison of monthly incomes of Daladala, BRT and railway users is show in Table 5.2.11 and Figure 5.2.16. The average monthly income of BRT users is higher than those of Railway users, while the monthly income of Daladala users is the lowest among the three.

Table 5.2.11 Average Monthly Income

	Daladala Users	BRT Users	Railway Users
Average Monthly Income (TZS)	378,429TZS	833,786TZS	1,071,597TZS



Source: JST

Figure 5.2.16 Comparison of Monthly Income for Each Public Transport Users

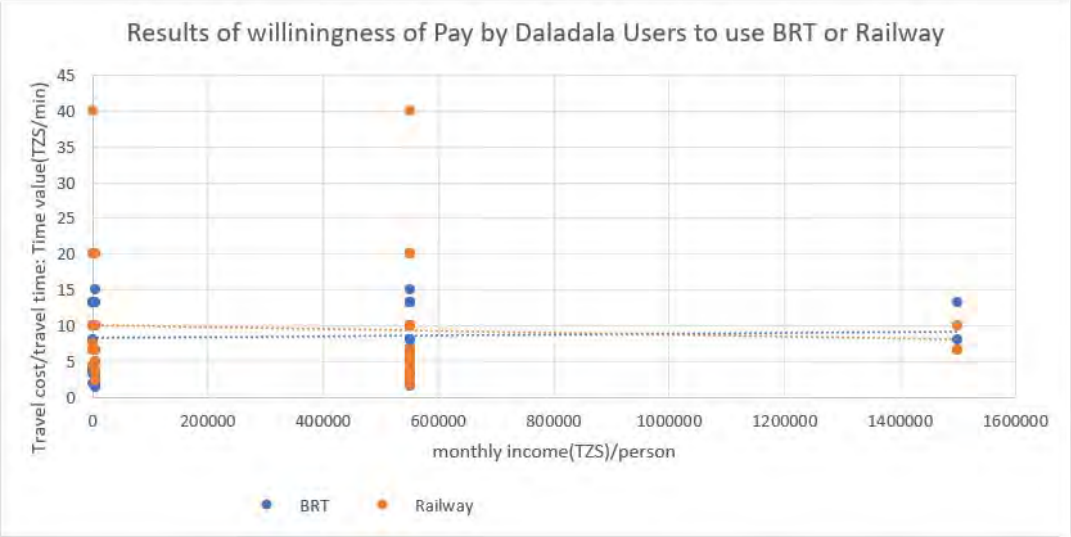
b) Willingness to Pay

Willingness to pay by Daladala users in BRT and Railway instead of using Daladala are shown as follows.

Table 5.2.12 Time Value by Daladala Users to use BRT and Railway

Description	Average of Time value(TZS/min)
Time value which is improvement of travel cost from Daladala to BRT / improvement of travel time from Daladala to BRT	5.0 TZS/min
Time value which is improvement of travel cost from Daladala to Railway / improvement of travel time from Daladala to Railway	2.9 TZS/min

Source: JST



Source: JST

Figure 5.2.17 Results of Willingness to Pay by Daladala Users to use BRT & Railway

(2) Results of Household Interview Survey (Person Trip Movement)

1) Number of Samples

Household interview surveys in 90 wards of DSM City were carried out by a sub-consultant from the end of January to the end of March. The number of samples for the household interview survey is 23,345 while the number of household members is 110,647. Valid samples recorded all of OD and purpose and transport mode in survey sheet. Sampling Rate of Each Ward exceeded 2.0% of the target rate that was based on 2012 census. Table 5.2.13 show the samples and expansion factor for household interview survey.

Table 5.2.13 Number of Samples

2017 HIS samples	Number of household (1,000)	a1	23
	Population (1,000)	a2	111
2012 Census	Number of household (1,000)	b1	1,098
	Population (1,000)	b2	4,365
2017 ※	Number of household (1,000)	c1	1,226
	Population (1,000)	c2	5,782
Sampling Rate ① (samples /2012)		a1/b1	2.1%
Sampling Rate ② (samples /2017)		a1/c1	1.6%
Expansion Factor		a2/c2	52

Note: 2017 data is from Local government.

Source: JST

2) Population Age Structure

The table below indicates the population for both the 2012 census and expected 2017 population. It is estimated that population will increase by 30%. The average household population increases by 0.7 per household and also indicate the number of population by each generation over the age of five. The

reason for removing the population of under five years old is there is no assumption that there will be independent trip of under five years old. The population increases in each generation. The structure ratio increases in 5~14 years old and 35~49 years old.

Table 5.2.14 Population and Number of Household（2012 - 2017）

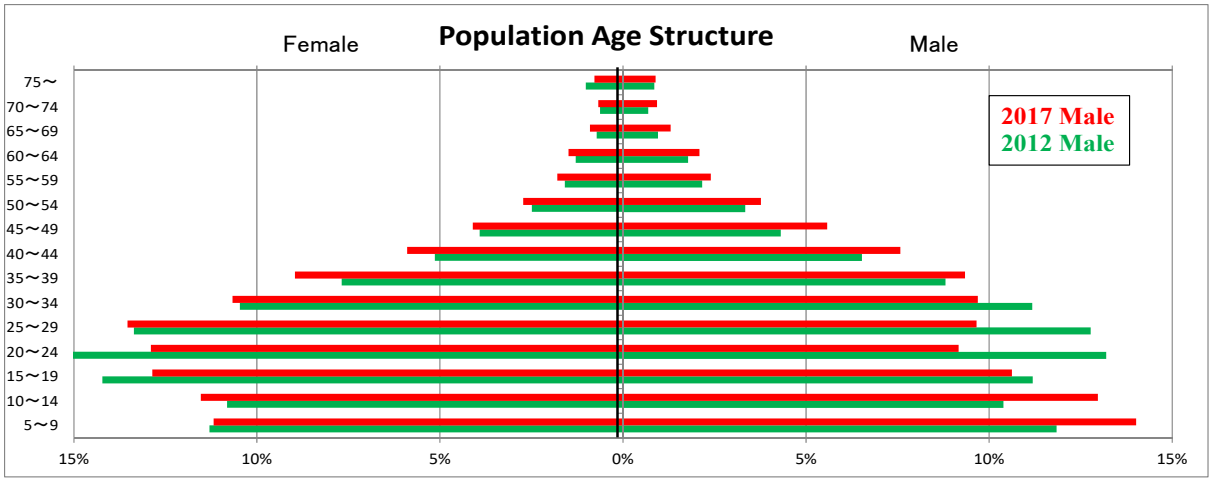
	Population (1,000)	Population 5 yrs old and above		No. of Households (1,000)	Average Household Size
		Male (1,000)	Female (1,000)		
2012 Census	4,365	1,861	1,976	1,087	4.0
2017 Samples Expansion Factor	5,783 (133%)	2,305	2,561	1,226 (113%)	4.7

Source: JST

Table 5.2.15 Population for each Generation

		Unit	5～14	15～24	25～44	45～59	60～69	70～	Total
2012	Male	person (1,000)	414	454	731	183	51	29	1,861
	Female		437	585	724	158	40	33	1,976
	Total		851	1,038	1,456	341	91	61	3,837
2017	Male	person (1,000)	622	456	836	271	78	42	2,305
	Female		582	660	1,001	221	61	37	2,561
	Total		1,204	1,116	1,837	491	139	79	4,867

Source: JST



Source: JST

Figure 5.2.18 Population Age Structure

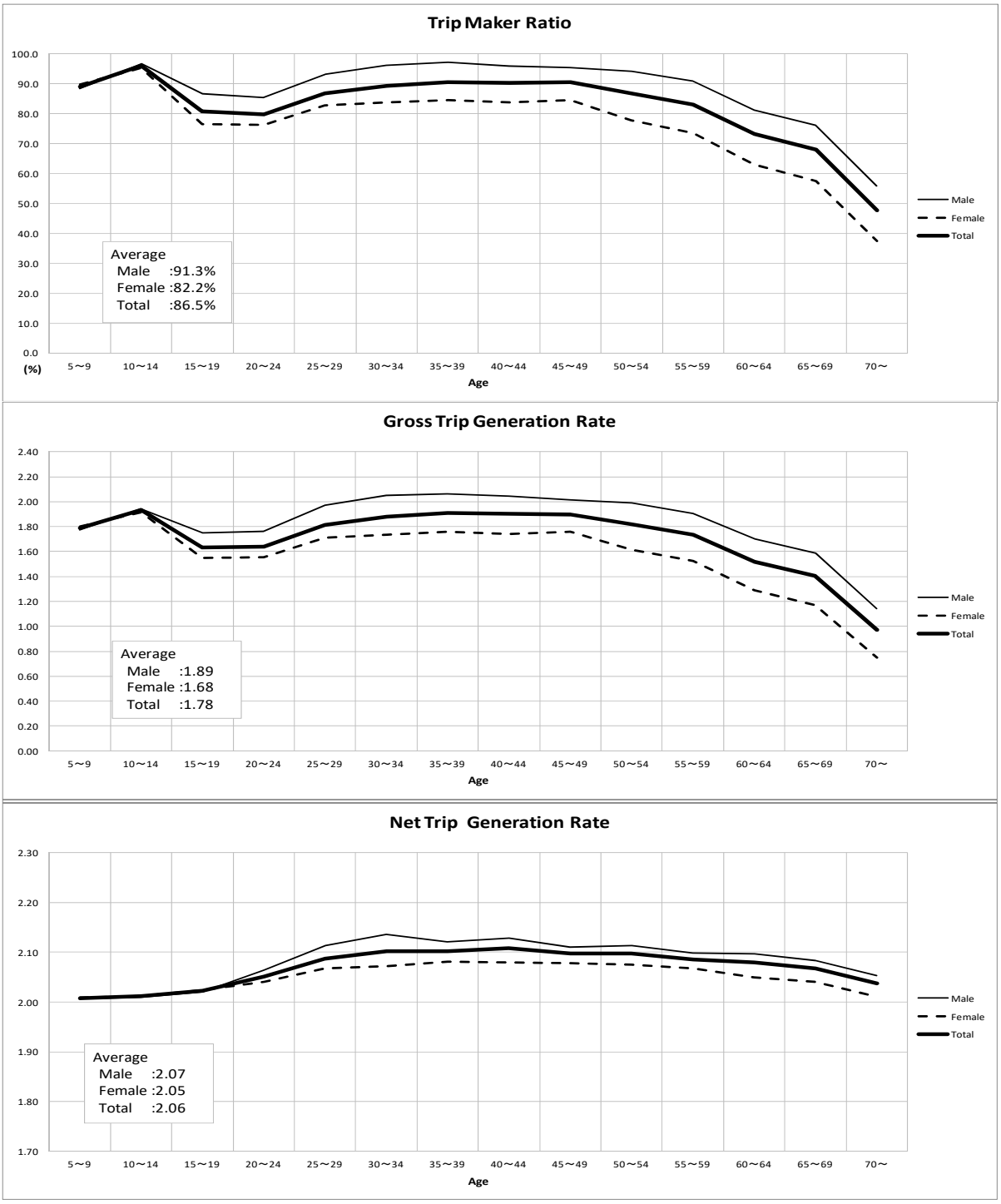
3) Total Trip Generation

Total Trip Generation indicates the number of trips and trip unit from HIS survey. In this case, the number of total trip is 8,674,000/day, the gross trip is 1.78, the net trip is 2.06. Trip maker ratio exceeds 90% in the young age (5～14) and working age male (25～49). Net trip generation rate is around 2.0 on all generations.

Table 5.2.16 Total Trip Generation

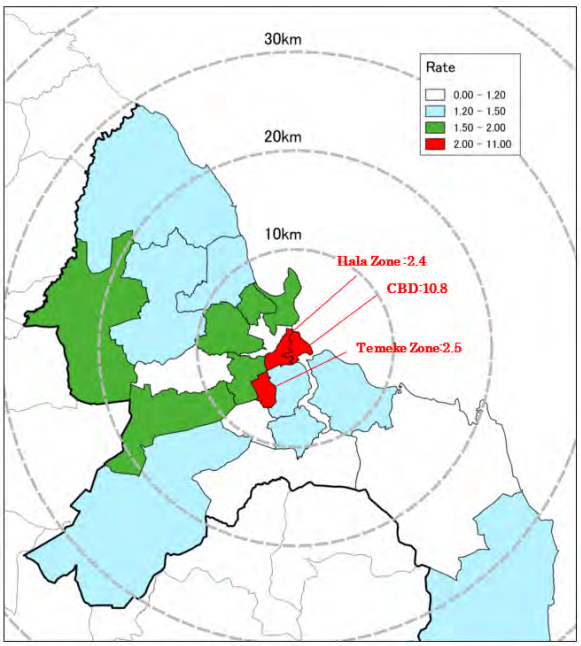
Item	Unit	Male	Female	Total
Estimated Population*	person (1,000)	2,305	2,561	4,867
No. of Trip Makers	person (1,000)	2,105	2,105	4,210
Trip Maker Ratio	%	91.3	82.2	86.5
Trip Generation	trip（1,000）/day	4,366	4,309	8,674
Gross Trip Generation Rate	trip/Person	1.89	1.68	1.78
Net Trip Generation Rate	trip/person	2.07	2.05	2.06
Item	Unit	Male	Female	Total

Note: Population 5 years old and above
Source: JST



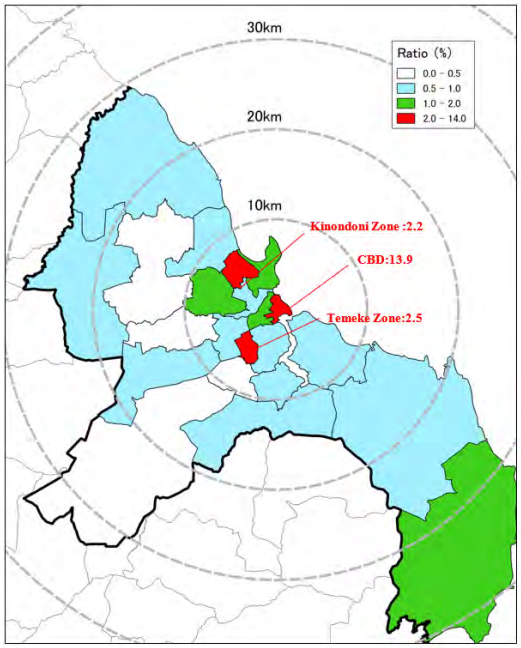
Source: JST

Figure 5.2.19 Trip Maker Ratio and Gross/Net Trip Generation Rate



Source: JST

Figure 5.2.20 Gross Trip Rate by Super Zone



Source: JST

Figure 5.2.21 Trip Generation Attraction Ratio

4) Trip Generation Attraction Ratio

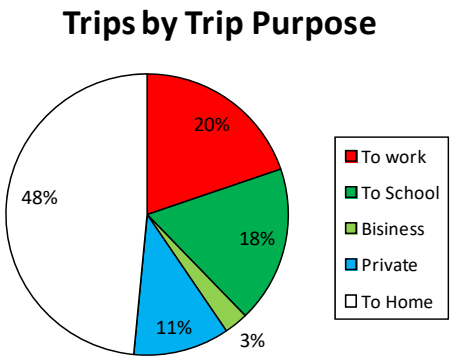
Figure 5.2.21 indicates trip generation by Super Zone. CBD zone has the highest trip generation attraction ratio. The further you go from CBD, the lower the trip generation.

5) Trip Purpose and Transport Mode

a) Trip by Trip Purpose

Figure 5.2.22 indicates trip ratio by purpose. The ratio of "to work" and "to school" was almost equal.

Unit: Person Trip / day



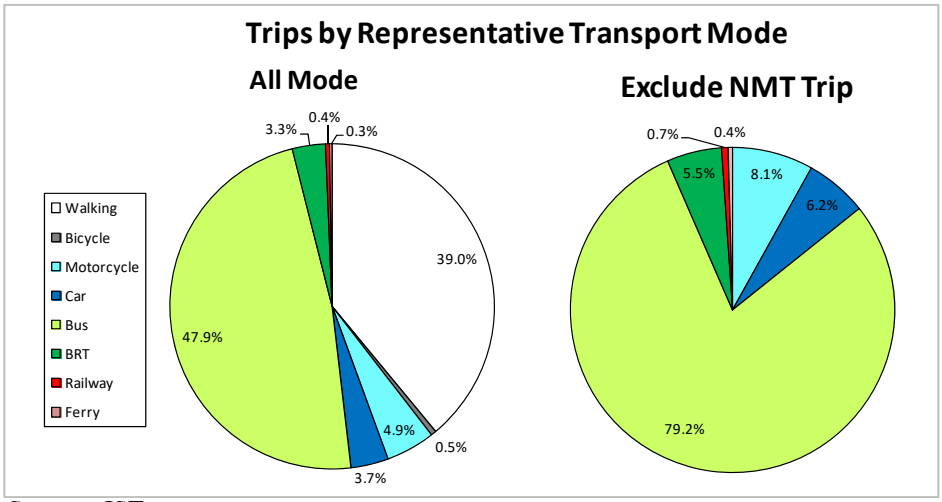
	Trips by Trip Purpose	
	Trips (1,000)	Ratio (%)
To work	1,714	19.6
To School	1,562	17.8
Business	238	2.7
Private	954	10.9
To Home	4,205	48.0
Total	8,674	99.1

Source: JST

Figure 5.2.22 Trip by Trip Purpose

b) Trip by Trip Transport Mode

This indicates all trips by mode and ratio of trip except NMP. The proportion "Walking" and "Bus" has the highest degrees in all trips. In case NMT is excluded, it is expected that demand of public transportation is high because 80% are bus users.



Source: JST

Figure 5.2.23 Trip by Trip Purpose

Unit: Person Trip day

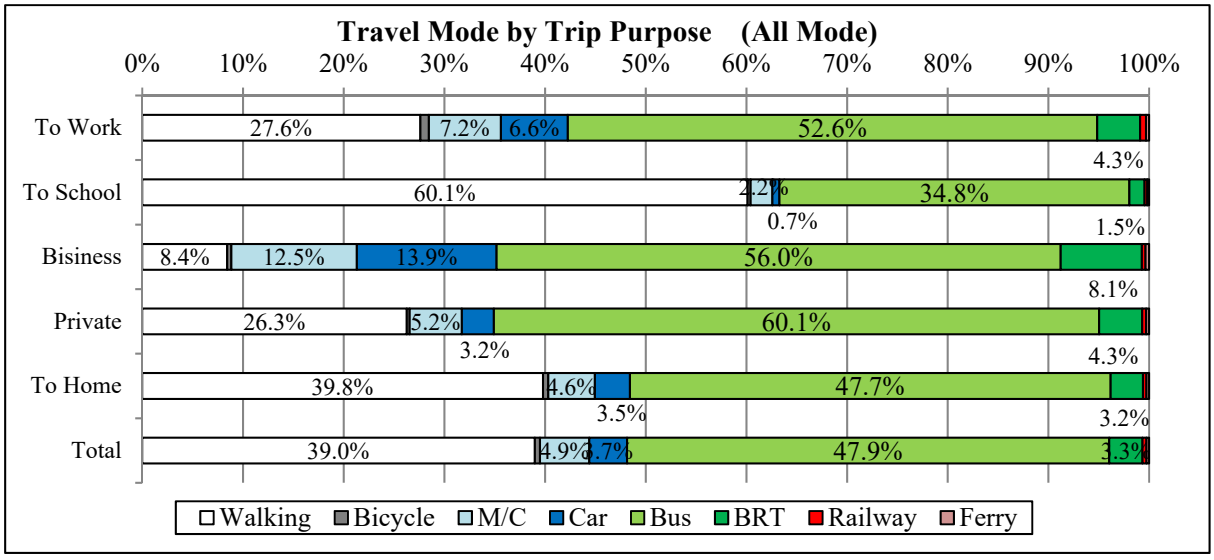
Table 5.2.17 Trip by Trip Purpose

	NMT			Motorized Transport							Total
	Walking	Bicycle	Sub Total	M/C	Car	Bus	BRT	Railway	Ferry	Sub Total	
Number of Trip (1,000)	3,381	45	3,426	424	325	4,155	287	34	23	5,248	8,674
All Mode Ratio (%)	39.0%	0.5%	39.5%	4.9%	3.7%	47.9%	3.3%	0.4%	0.3%	51.9%	100%
Exclude NMT Ratio (%)	-	-	-	8.1%	6.2%	79.2%	5.5%	0.7%	0.4%	100%	100%

Source: JST

c) Travel Mode by Trip Purpose

The following figure indicates each trip ratio by purpose and resort; 60% of "To School" is by walking, 50% of "To Work" and "Business" is by bus.



Source: JST

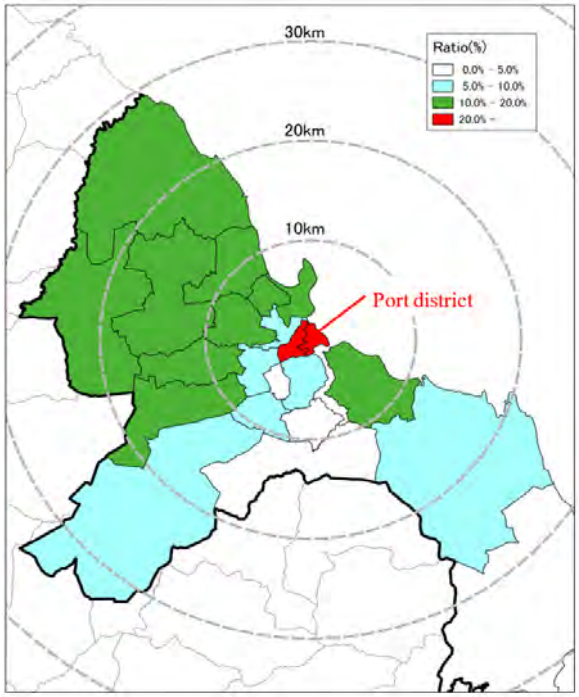
Figure 5.2.24 Travel Mode by Trip Purpose

6) Vehicle Ownership

a) Vehicle Ownership / Household

Figure 5.2.25 and 26 indicates ratio of vehicle ownership by household. Around the CBD and North area, vehicle ownership ratio is high compared to South area.

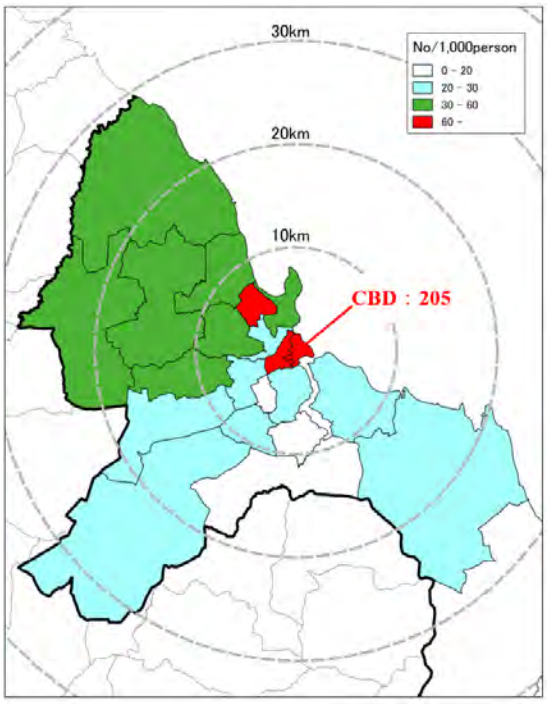
Vehicle Type		Car	M/C
Household (1,000)		1,226	
Ownership	None	1,093 (89.1%)	1.127 (91.9%)
	1 or more	133 (10.9%)	99 (8.1%)



Source: JST

Figure 5.2.25 Car Ownership per Household by Zone

Population (1,000)		5,782
Car Ownership	No of Car	191,825
	No of cars / 1,000 person	33.2



Source: JST

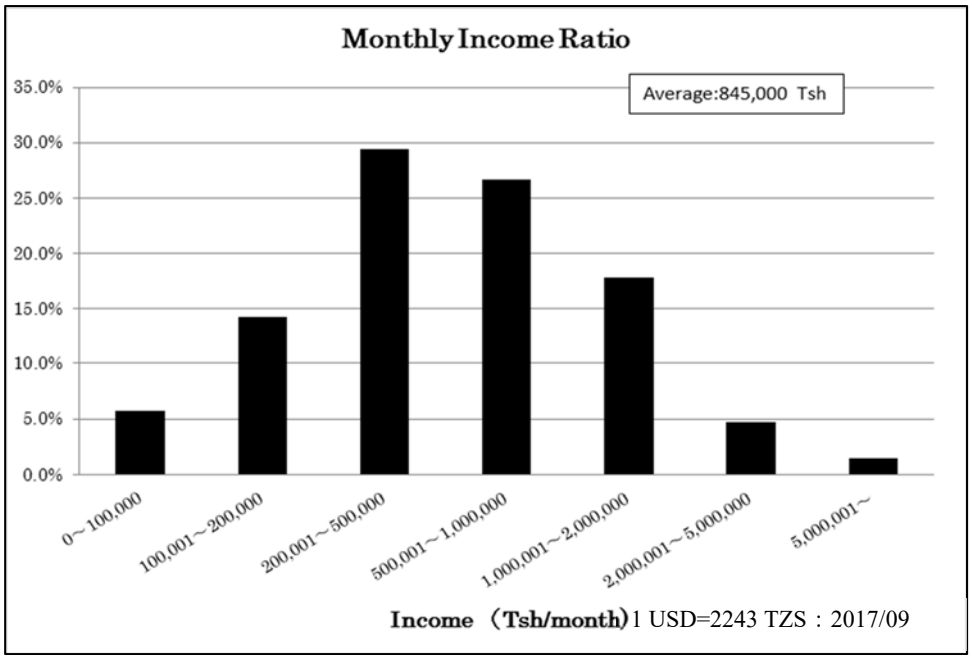
Figure 5.2.26 Car Ownership per 1,000person by Zone

b) Vehicle Ownership / 1,000person

The figure above indicates car ownership and vehicle ownership/1,000 people by zone. The households around the CBD and North area are high, and low around the South area. It is the same as the ratio of car ownership by household.

7) Income

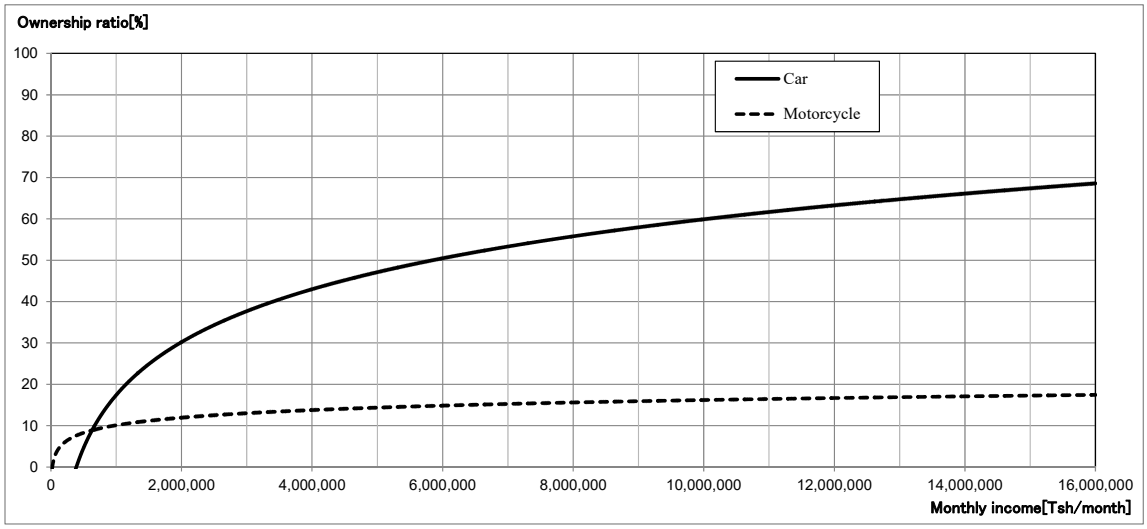
The distribution of monthly income ratio by household is shown below. The households that have a monthly income of 200,001～500,000 (TZS/Month) occupy 30% of all households.



Source: JST

Figure 5.2.27 Monthly Income Ratio

Figure 5.2.28 indicates the distribution of vehicle ownership by household income level. Regarding M/C, there are no large gaps in each household income. On the other hand, car ownership ratio of households with a monthly income of 700,000 TZS has the average ownership ratio in DSM (10.9%). When the monthly household income exceeds 6,000,000 TZS, car ownership ratio goes over 50%.



Source: JST

Figure 5.2.28 Vehicle Ownership by Household Income

8) Trip Peak Ratio

Figure 5.2.29 indicates distribution of main trip by hour. (Left side: Generated, Right side: Attracted)
Generated: trip

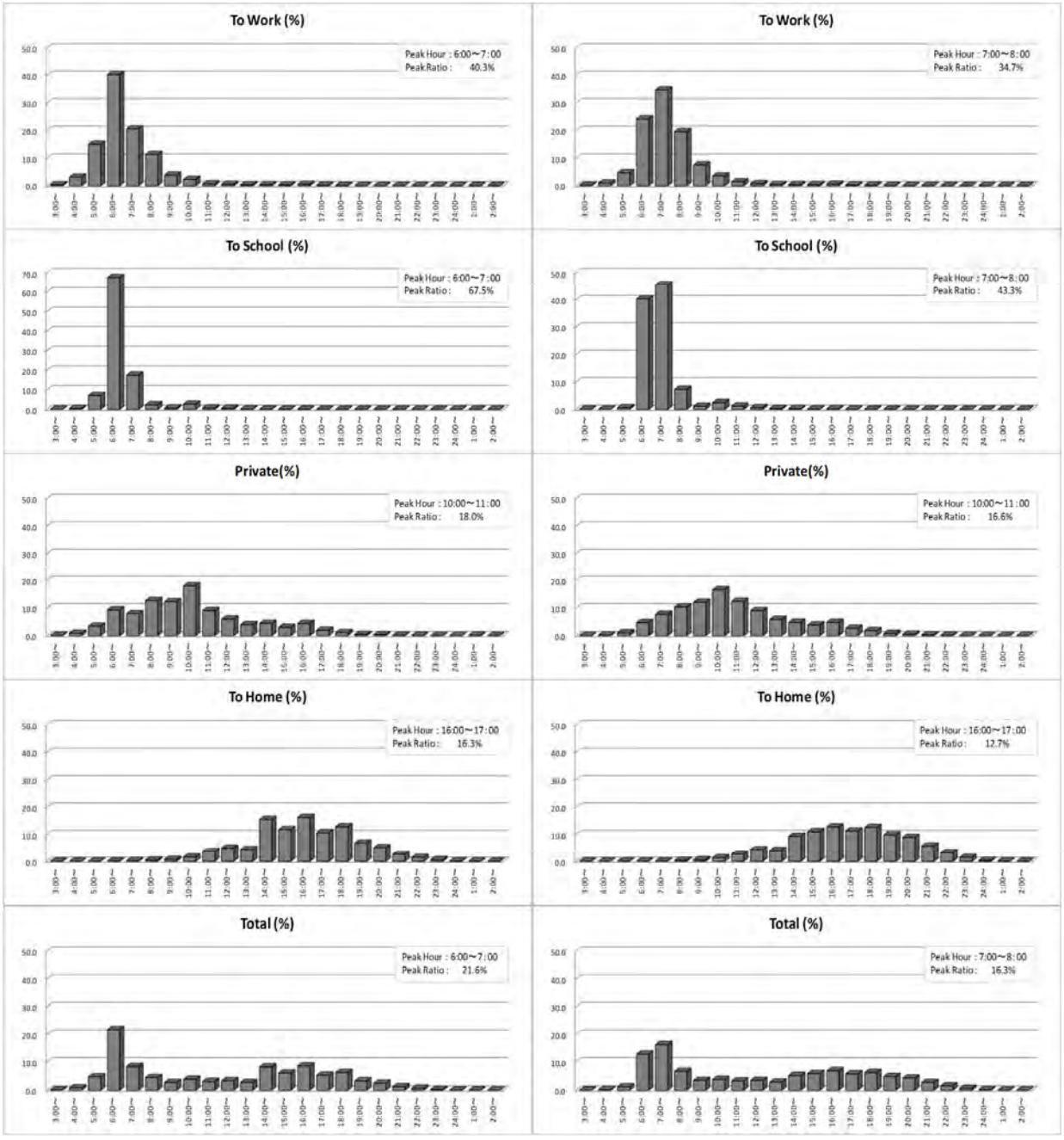
- The peak hour of "To work" is 6：00～7：00, peak rate is 40.3%.
- The peak hour of "To School" is 6：00～7：00, peak rate is 67.3%.

- The peak hour of "To Home" is 16：00～17：00, it is dispersed to 14：00～19：00.

Attracted: trip

- The peak hour of "To work" is 7：00～8：00, peak rate is 34.7%.
- The peak hour of "To School" is 6：00～7：00, peak rate is 43.3%.
- The peak hour of "To Home" is 6：00～7：00, it is dispersed to 14：00～19：00.

Generated　　Attracted

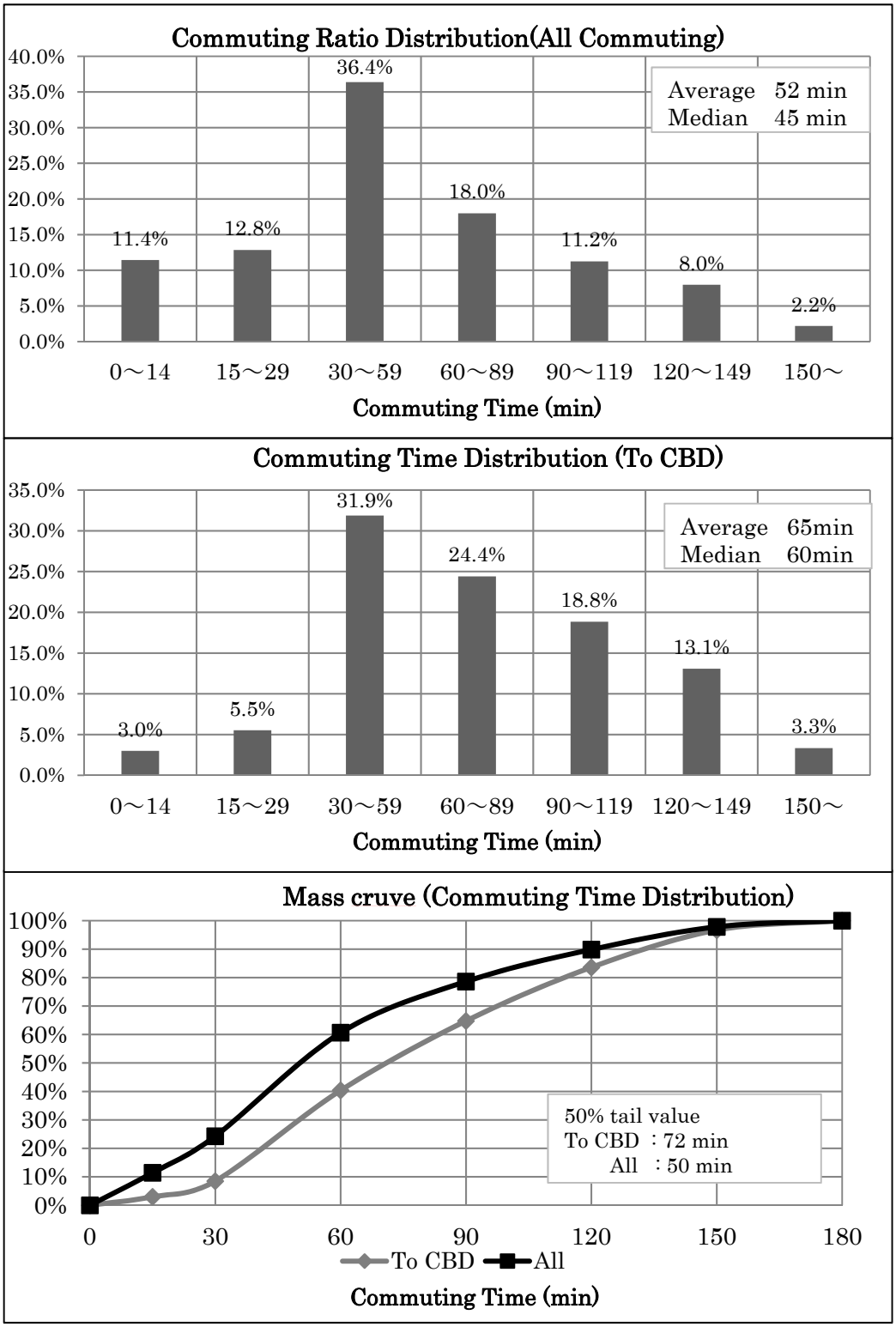


Source: JST

Figure 5.2.29 Trip Peak Ratio

9) Commuting Time Distribution

The time of all CBD trips is shown in Figure 5.2.30. The average commuting time to CBD is more than one hour; it is longer than commuting time of each resort.

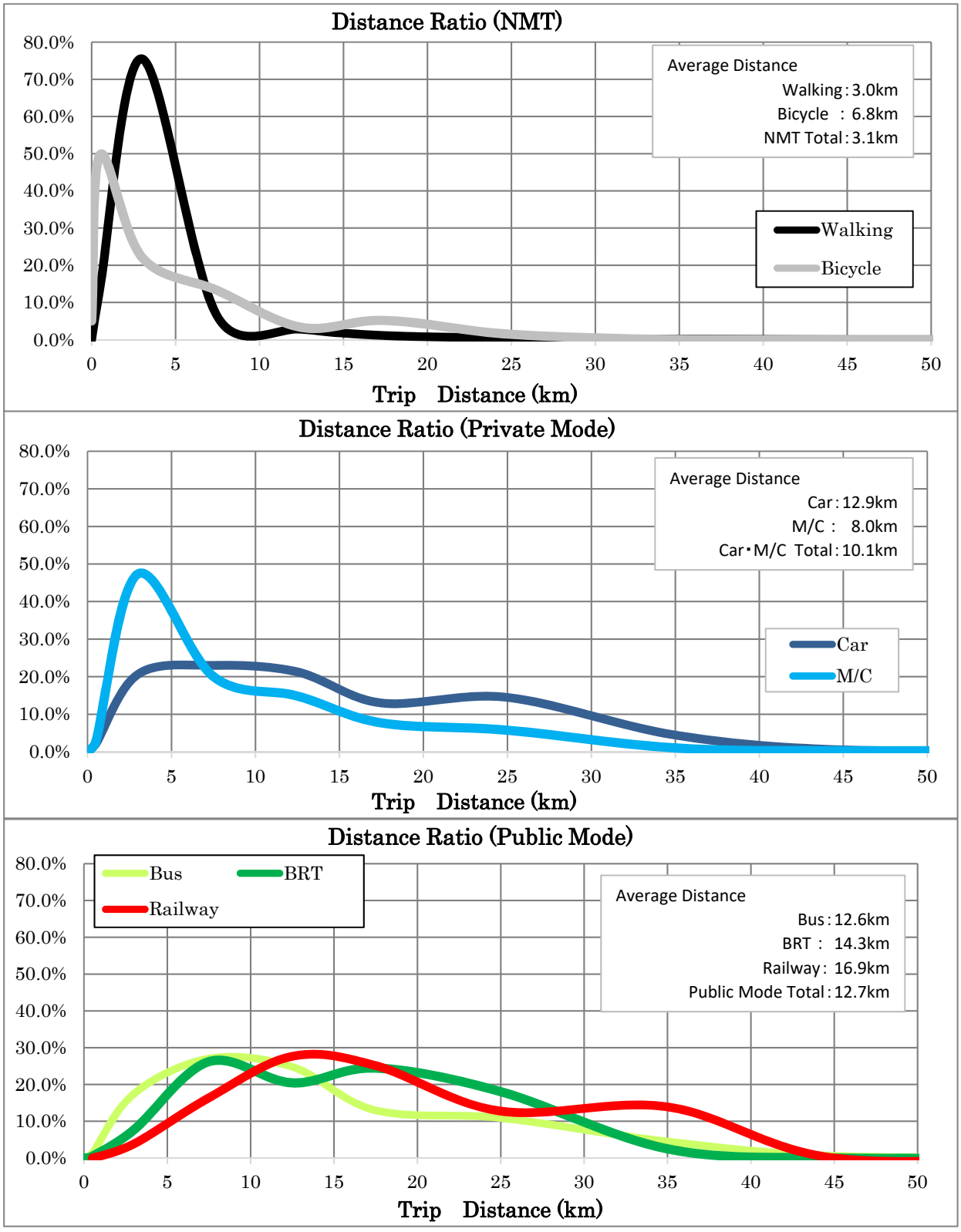


Source: JST

Figure 5.2.30 Commuting Time Distribution

10) Trip Distance

Figure 5.2.31 indicates long trip distance ratio by mode. The railway is longest; followed by car and bus. These are longer than the average distance of 10km. Detailed data for Trip Distance Distribution by Transport Mode is shown in the Annex.



Source: JST

Figure 5.2.31 Trip Distance by Transport Mode

11) Comparison of the Survey on 2007 and 2017

The result of comparison for HIS 2007 and 2017 by main items is summarized as follows.
*HIS 2017 data is extracted by "Dar es Salaam Transport Policy and System Development Master Plan Technical Report 6, 2008/ 06, JICA"

a) Total Trip Generation

Table 5.2.18 shows trip generation rates. All trips increased by more than three times, and gross trip increase is by 1.5 times.

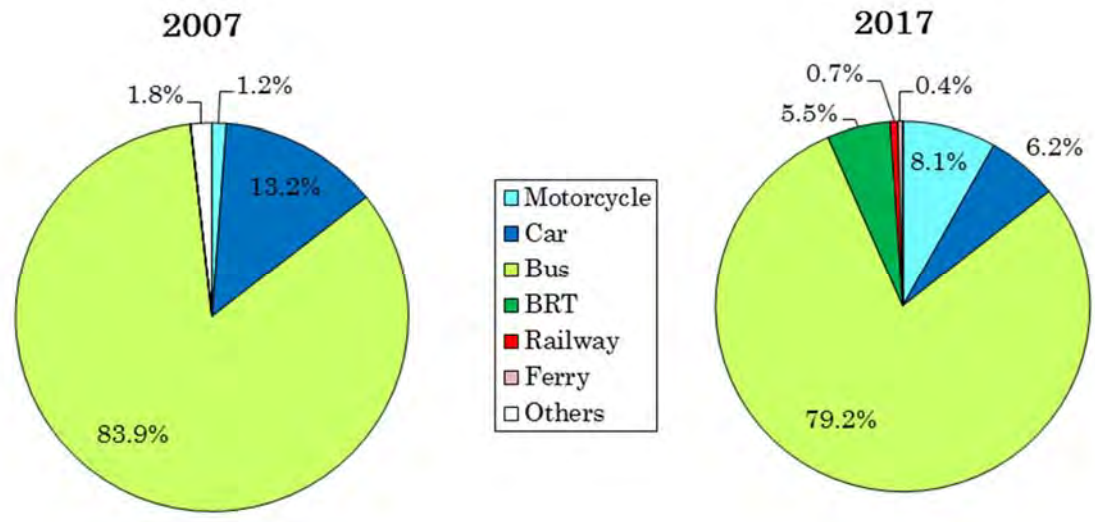
Table 5.2.18 Total Trip Generation

Item		Unit	2017	2007	2017/2007
Population	(A)	person (1,000)	4,867	2,410	2.02
No. of Trip Makers	(B)	person (1,000)	4,210	1,166	3.61
Trip Maker Ratio	(=B/A)	(%)	86.5	48.4	1.79
Trip Generation	(C)	trip (1,000) /day	8,674	2,873	3.02
Gross Trip Generation Rate	(=C/A)	(trip/person)	1.78	1.19	1.50
Net Trip Generation Rate	(=C/B)	(trip/person)	2.06	2.46	0.84

Source: JST

b) Trip by Transport Mode

Figure 5.2.32 compares trip structure by mode.



Source: JST

Figure 5.2.32 Trip by Transport Mode excl. NMT (2007-2017)

Table 5.2.19 Total Trip Generation

Number of Trip	NMT			Motorized Transport								Total
	Walking	Bicycle	Sub Total	Motorcycle	Car	Bus	BRT	Railway	Ferry	Other	Sub Total	
2017	3,381	45	3,426	424	325	4,155	287	34	23	-	5,428	8,674
2007	744	40	784	25	276	1,752	-	-	-	37	2,090	2,874
2017/2007	4.54	1.14	4.37	17.24	1.18	2.37	-	-	-	-	2.60	3.02

Source: JST

c) Vehicle Ownership

The ownership ratio M/C and car by household comparison is shown below. The ownership ratio of M/C increased by 1.80 times, and the car ownership ratio increased by 1.09 times.

Table 5.2.20 Ownership by Vehicle Type

Vehicle Type		2007	2017	2017/2007
Household (1,000)		708	1,226	1.73
Motorcycle	Ownership Household (1,000)	32	99	3.12
	Ratio	4.5%	8.1%	1.80
Car	Ownership Household (1,000)	71	134	1.89
	Ratio	10.0%	10.9%	1.09

Source: JST

The table below indicates and compares the car ownership/1,000 person. The population increased by 1.9 times, number of cars increased by 2.44 times. Car ownership/1,000person increased by 1.28 times. It is a little higher than ownership ratio by household.

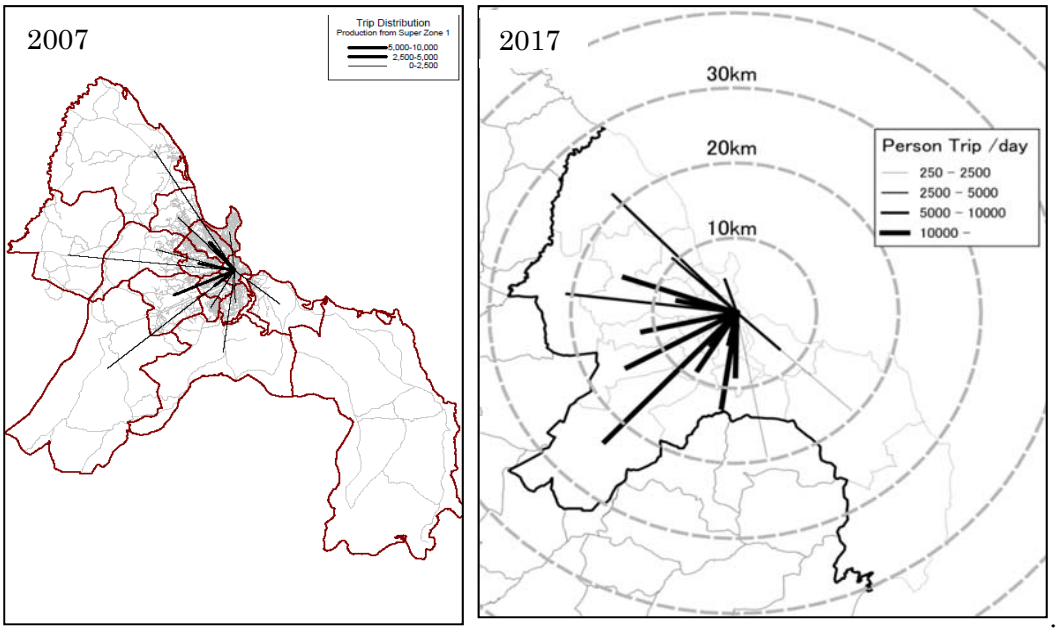
Table 5.2.21 Car Ownership / 1,000person

	2007	2017	2017/2007
Population (1,000)	3,030	5,782	1.90
No of cars	78,477	191,825	2.44
No of cars /1,000person	25.9	33.2	5.28

Source: JST

d) Commuting to CBD

Desired line for commuting to CBD is shown as in Figure 5.2.33. Commute is expanding compare to 2017.



Source: JST

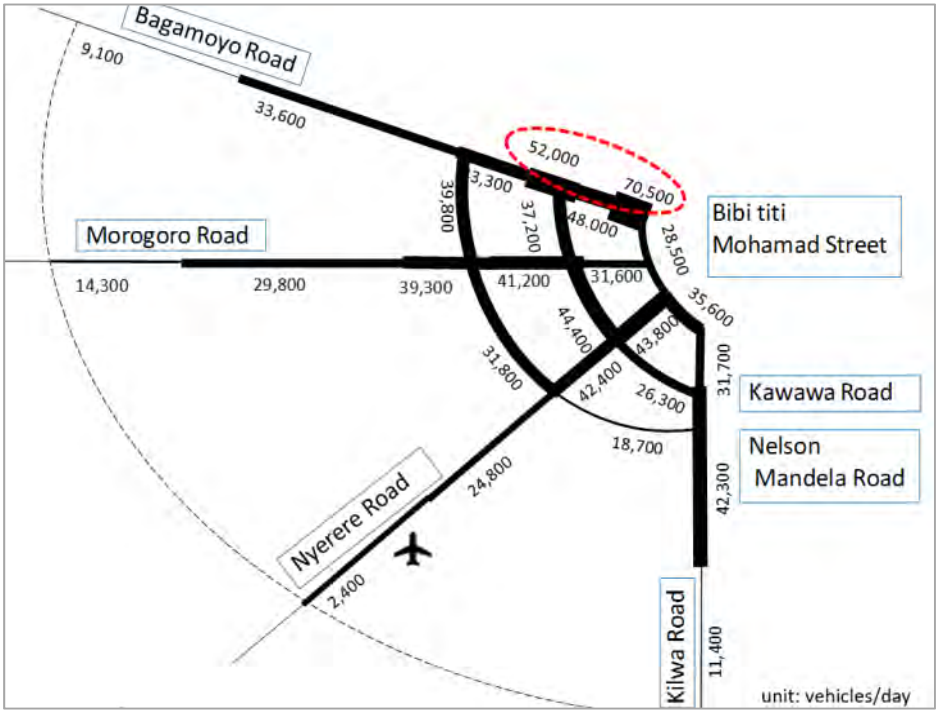
Figure 5.2.33 Desire Line for Commuting

5.2.3 Vehicle Movement

(1) Traffic Volume

1) Vehicle Traffic Volume/day

Traffic volumes (vehicles/day) at each survey point are shown in below. The section with the largest traffic volume exceeding 50,000 vehicles per day is along Bagamoyo Road, between Kawawa Road Junction to Selander Bridge.



Source: JST

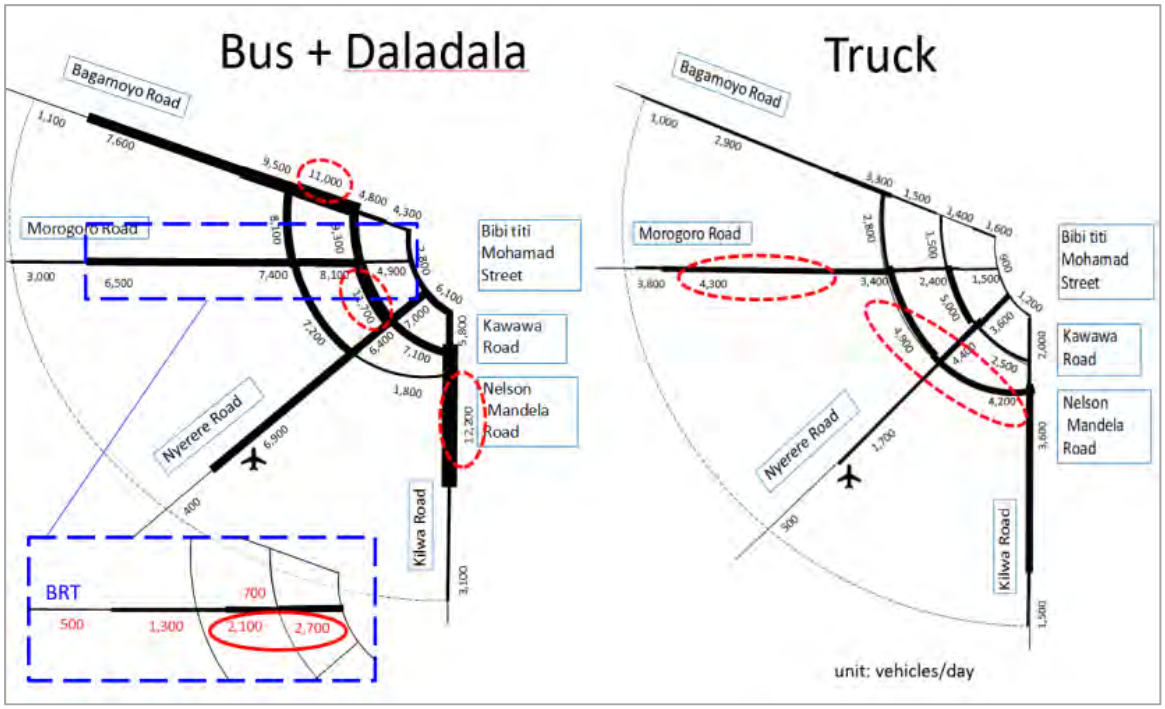
Figure 5.2.34 All Vehicle Traffic Volume (vehicle/day) in year 2017

For the bus and Daladala, the sections with the largest traffic volumes exceeding 10,000 vehicles are:

- Bagamoyo Road (Kawawa Road to Nelson Mandela Road Section): 11,000 vehicles/day
- Kigogo Road (Morogoro Road to Nyerere Road Section): 11,700 vehicles/day
- Kilwa Road (Chang'ombe Road to Mbagala Section): 12,200 vehicles/day

For the trucks, the largest traffic volumes exceeding 4,000 vehicles are at the following three sections:

- Morogoro Road (Mbezi to Ubungo Section): 4,300 vehicles/day
- Nelson Mandela Road (Morogoro Road to Nyerere Road Section): 4,900 vehicles/day
- Nelson Mandela Road (Nyerere Road to Kilwa Road Section): 4,200 vehicles/day



Source: JST

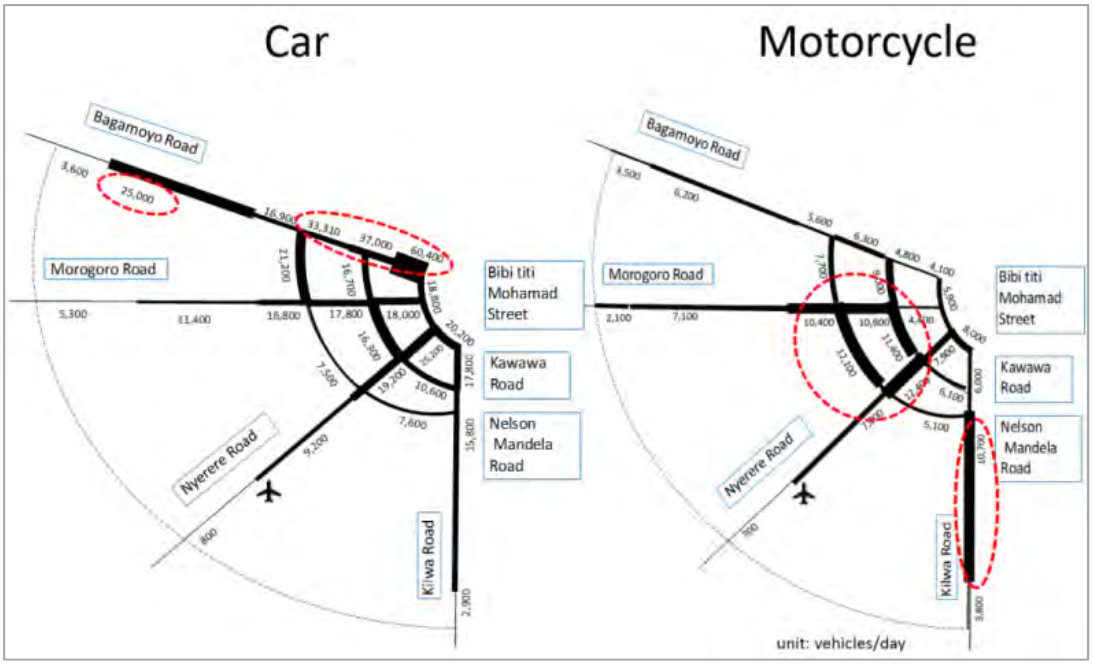
Figure 5.2.35 Vehicle Traffic Volume (Bus and Daladala, Truck)

For the passenger cars, the largest traffic volume exceeding 20,000 vehicles was recorded as follows:

- Bagamoyo Road (Tegeta to Selander Bridge Section): 25,200 – 60,400vehicles/day
- Sam Nujoma Road: 21,200vehicles/day

For the motorcycles, the largest traffic volume, with more than 10,000 vehicles, are along the following five sections:

- Morogoro Road (Ubungo to Kawawa Road Section): 10,400-10,600 vehicles/day
- Kigogo Road (Morogoro Road to Nyerere Road Section): 11,400 vehicles/day
- Nelson Mandela Road (Morogoro Road to Nyerere Road Section): 12,100 vehicles/day
- Nyerere Road (Kigogo Road to Nelson Mandela Road Section): 12,400 vehicles/day
- Kilwa Road (Nelson Mandela Road to Mbagala Section): 10,700 vehicles/day

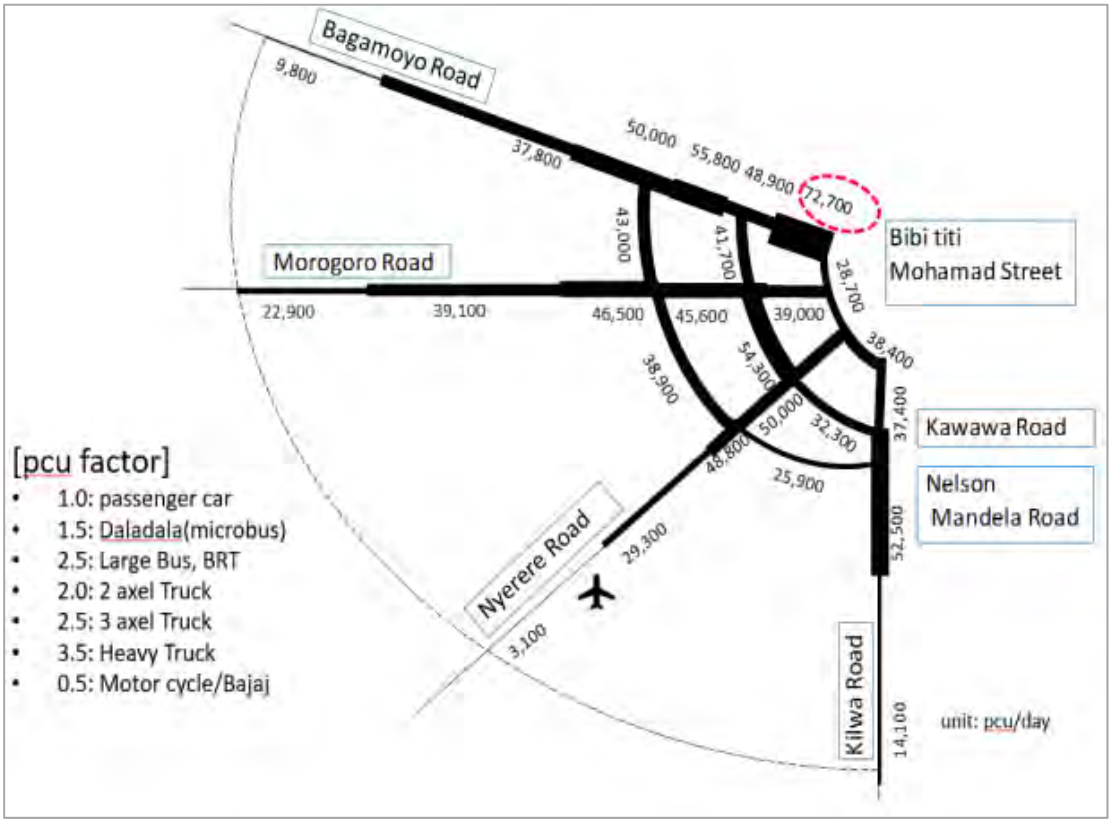


Source: JST

Figure 5.2.36 Vehicle Traffic Volume (Car, Motorcycle)

2) Traffic Volume (pcu/day)

Traffic volumes (pcu/day) are calculated by using pcu factors for each vehicle type based on the Tanzanian standard. The largest traffic volume (pcu/day) is recorded at the Selander Bridge on Ali Hassan Mwinyi Road with 72,200pcu/day.

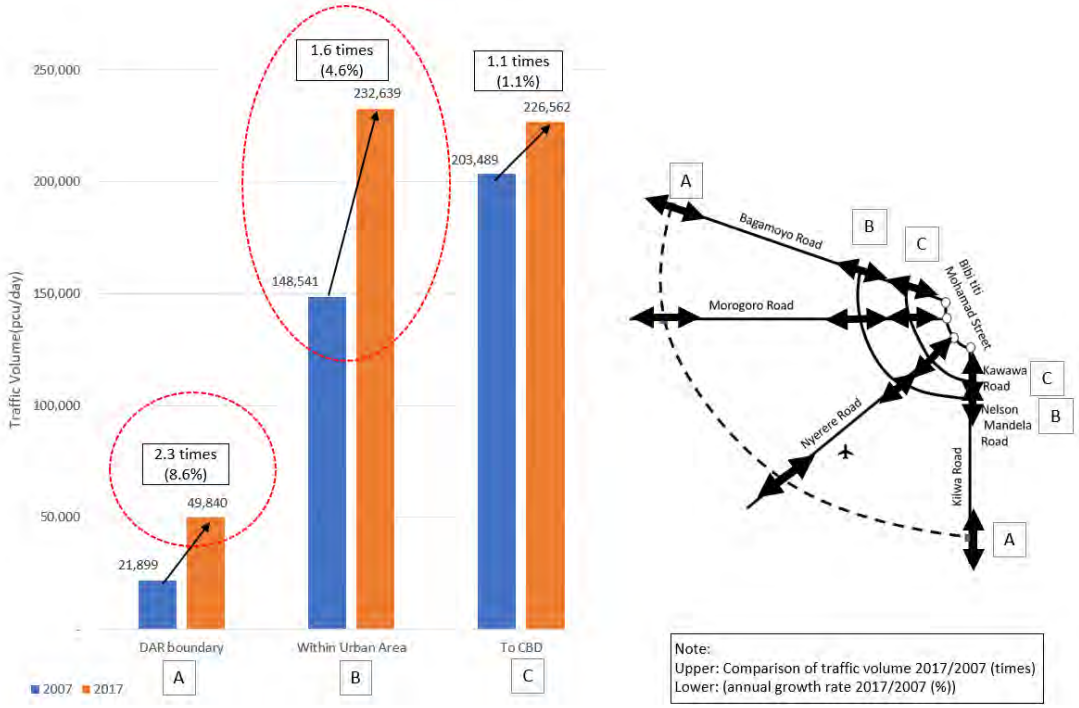


Source: JST

Figure 5.2.37 Traffic Volume (pcu/day)

3) Comparison between Survey in 2007 and in 2017

Traffic volume at Dar es Salaam boundary has increased the most by 2.3 times from year 2007 to year 2017. Traffic volume at Nelson Mandela Road has also increased by 1.6 times from year 2007 to year 2017. Traffic volume along Bagamoyo Road has dramatically increased from year 2007 to year 2017. Current traffic conditions of the traffic volume increase from year 2007 to year 2017 are shown below.



Source: JST

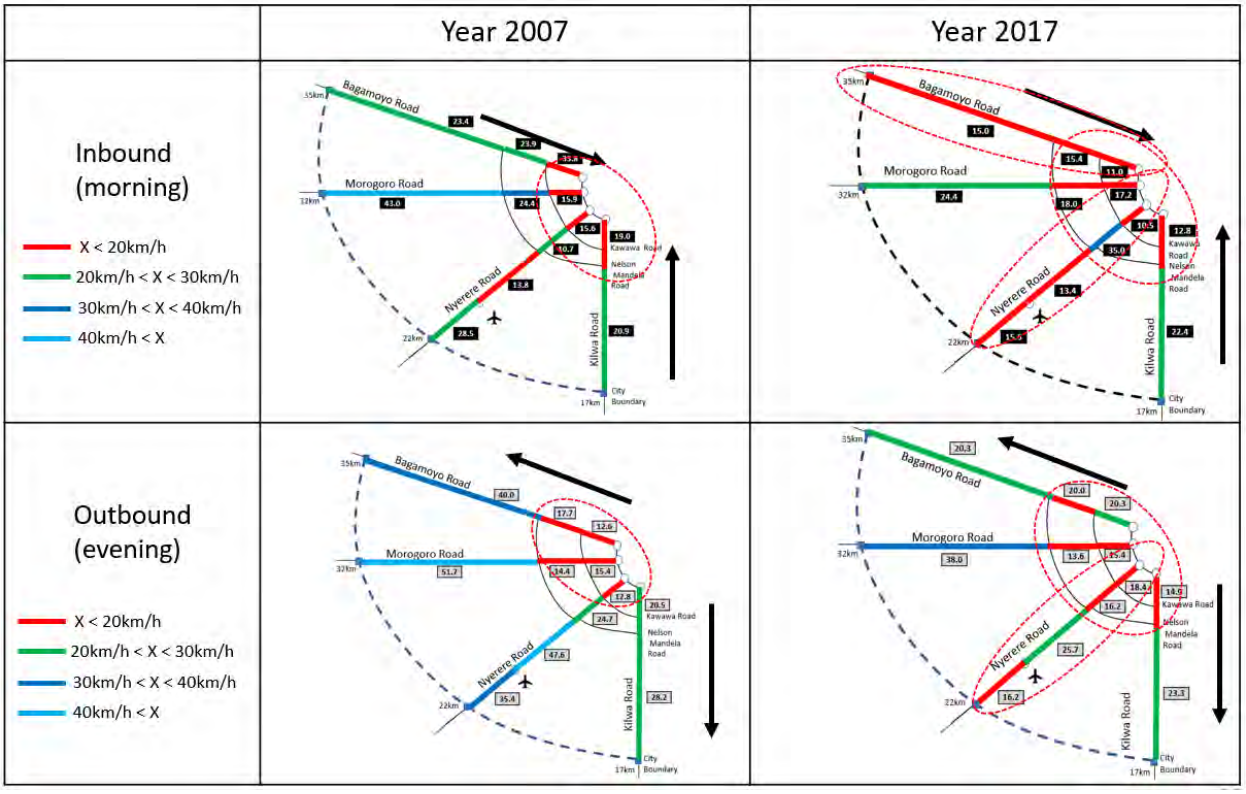
Figure 5.2.38 Comparison of Traffic Volume between Survey in 2007 and in 2017

Source: JST

Figure 5.2.39 Comparison of Traffic Volume between Survey in 2007 and in 2017 on Major Roads

(2) Travel Speed/Time

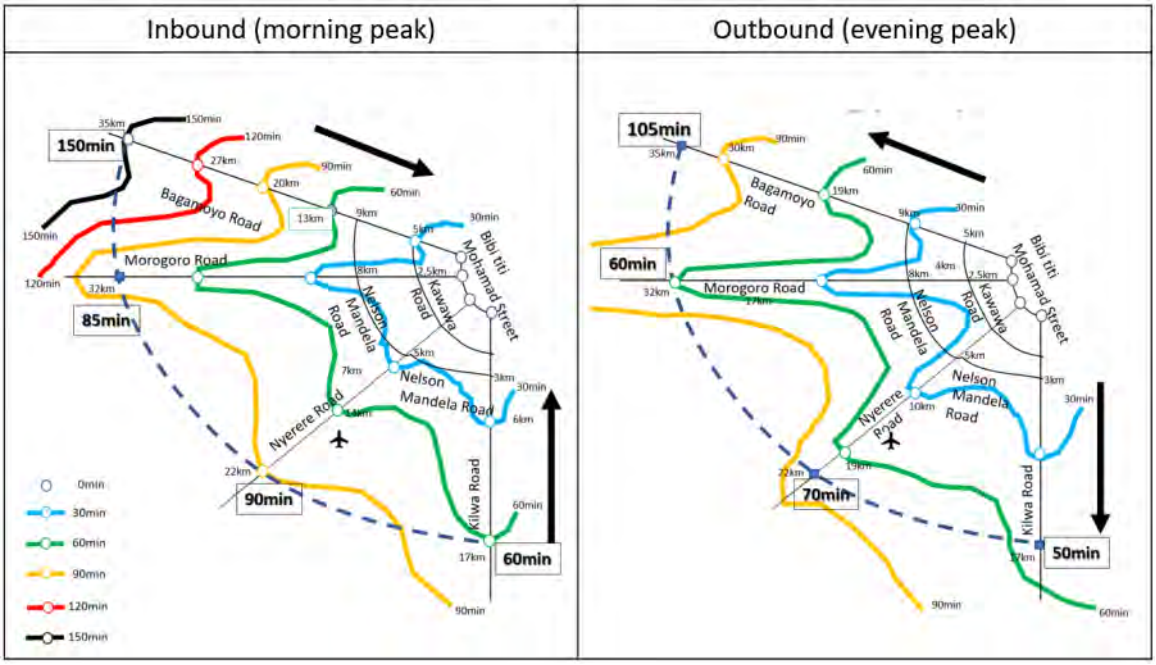
Based on the survey results of travel speed, current travel speed and former travel speed in year 2007 along radial trunk roads are shown in the following figure. Comparing the current data of 2017 with the ones of 2007; the areas with the travel speed of less than 20km/h along radial trunk roads have been expanded as shown in Figure 5.2.40. In particular, the travel speed within Nelson Mandela Road, along Bagamoyo Road and Nyerere Road has decreased.



Source: Travel Speed Survey on Feb.07, 2017, JST

Figure 5.2.40 Travel Speed along Radial Trunk Roads between Year 2007 and 2017

Current travel times of inbound at morning peak hours and outbound at evening peak hours are shown in Figure 5.2.41. Among the trunk roads, Bagamoyo Road recorded the heaviest congestion. It took approximately 2.5 hours at morning peak hours from the city boundary to CBD (inbound) along Bagamoyo Road. In the evening, travel from CBD to outbound took one hour and 45 minutes. Travel time from city boundary to CBD (inbound) along Morogoro Road and Nyerere Road recorded approximately 1.5 hours. Travel time along Kilwa Road is also around one hour. Outbound traffic along Morogoro Road and Nyerere Road at the evening peak hours were also recorded more than one hour.



Source: Travel Speed Survey on Feb.07, 2017, JST

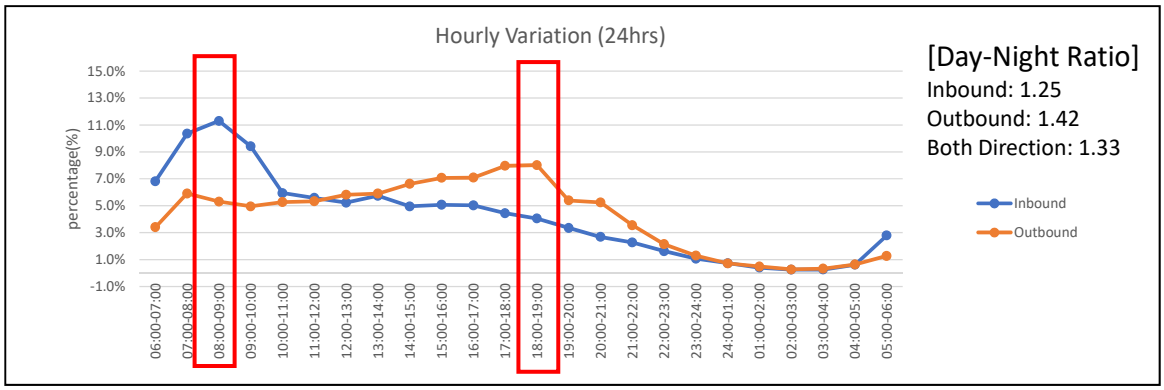
Figure 5.2.41 Travel Time

(3) Hourly Variation

Peak Time is recorded 8:00～9:00, and 18:00～19:00 in the entire DSM city. Peak Ratio of Inbound/Outbound on Nelson Mandela Road is the highest.

1) Day-Night Ratio

Regarding as the result of 24 hour counts survey, day-night ratio is 1.33 for both directions. Day-night ratio for inbound is 1.25 and for outbound is 1.42.



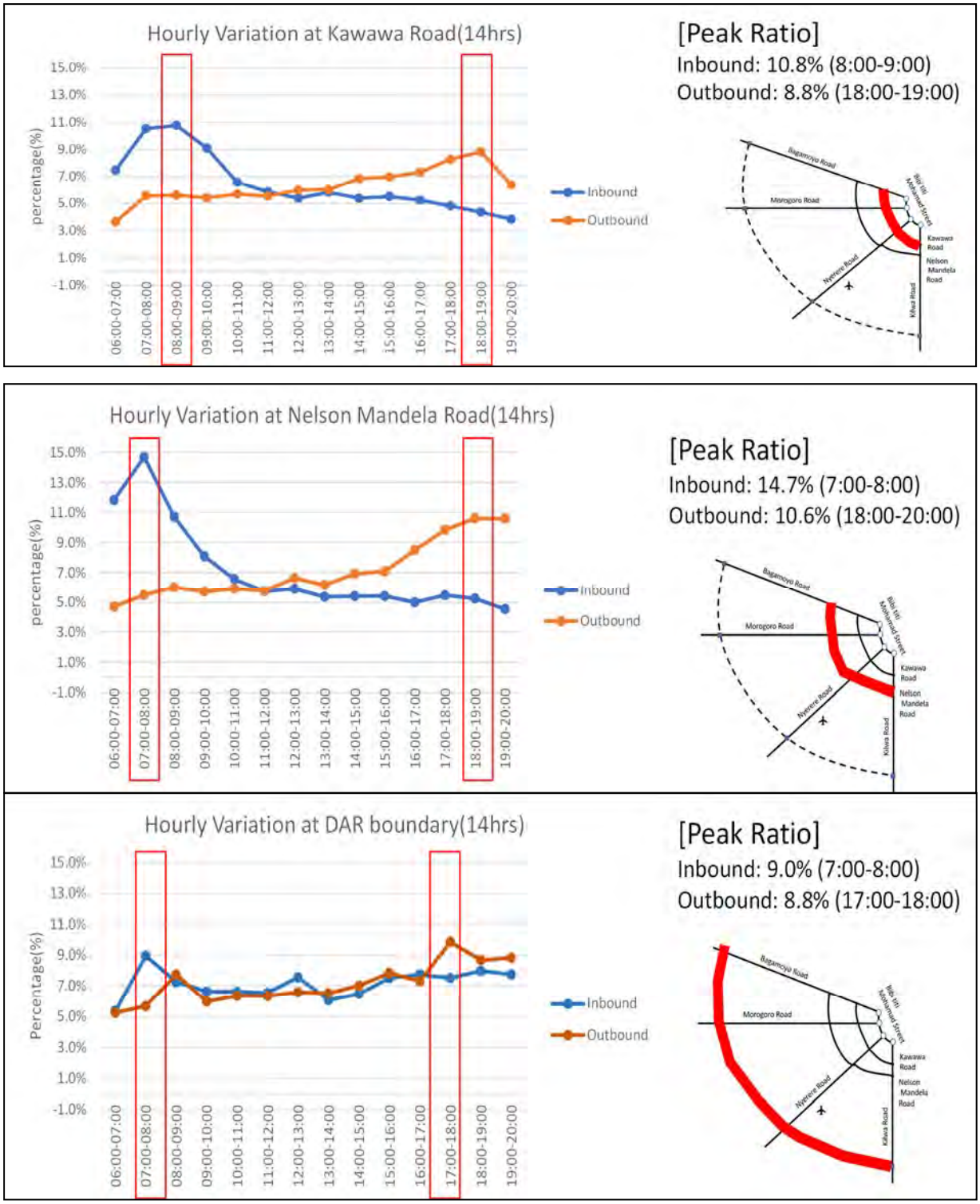
Source: JST

Figure 5.2.42 Hourly Variation / Day-Night Ratio

2) Peak Ratio

Peak ratio along Kawawa Road, Nelson Mandela Road and Dar boundary are shown as follows.

Peak hour for inbound at Dar boundary and Nelson Mandela Road (am7:00-am8:00) was earlier than at Kawawa Road (am8:00-am9:00). Peak hours for outbound from city centre was from pm 6:00 to pm 8:00 at Nelson Mandela Road.



Source: JST

Figure 5.2.43 Hourly Variation / Peak Ratio

3) D-value

D-value on radial trunk roads and ring roads on morning and evening peak hours are shown as follows. Average of D-value in morning peak hours are more than the numbers of d-value in evening peak hours.

Each D-value at survey points are attached in the Annex.

Table 5.2.22 Average D-value on Radial Roads and Ring Roads

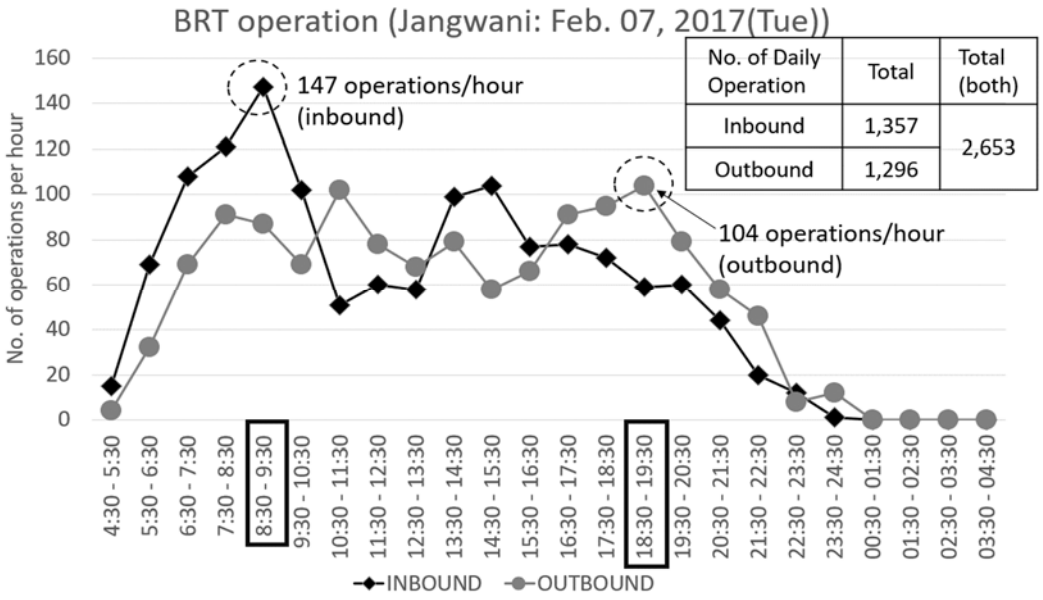
Survey Location	Morning Peak	Evening Peak	Survey Points
Radial Trunk Road	0.696	0.643	20 points CL-1,2,3,4,5 SL1-1, 1-2, 1-3, 1-4, 1-5, 2-6, 2-7, 3-11 TVC-1,2,7,11,12,13,14
Ring Road	0.657	0.650	12 points SL2-8, 2-9, 3-10, 3-12, 16 TVC-3, 4, 5, 6, 8, 9, 10

Source: Traffic Survey by JST

(4) Current BRT Operation

BRT operated daily at 2,653 times on both directions as shown in following figure.

Morning peak hour was from 8:30 to 9:30a.m. for inbound and had 147 operations/hour. On the other hand, evening peak hour for outbound was from 6:30 to 7:30p.m. and had 104 operations/hour.

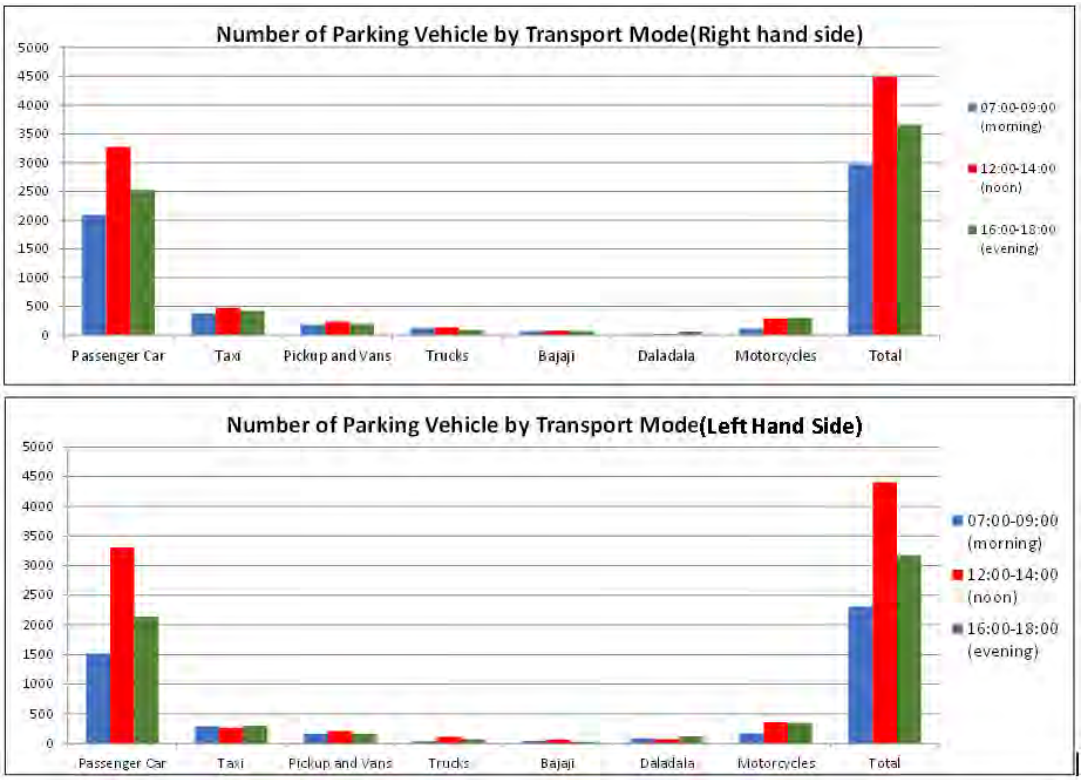


Source: JST

Figure 5.2.44 Current BRT Operation

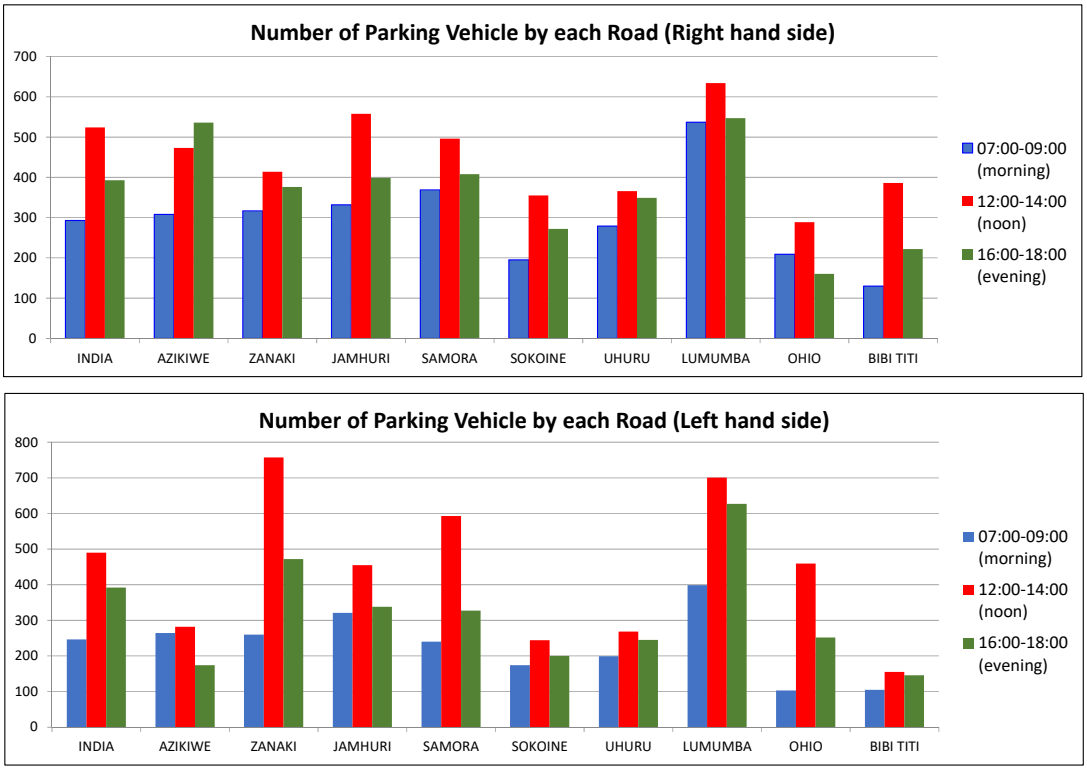
(5) Road Parking Survey

The result of road parking survey as spotted in the morning, noon and night is shown in the figure below. The number of passenger cars is the highest in the result by mode; it occupies 80%. There are almost no M/Cs. The No.8 LUMUMBA Road is largest in the result by spot. The peak time is at noon at almost all roads.



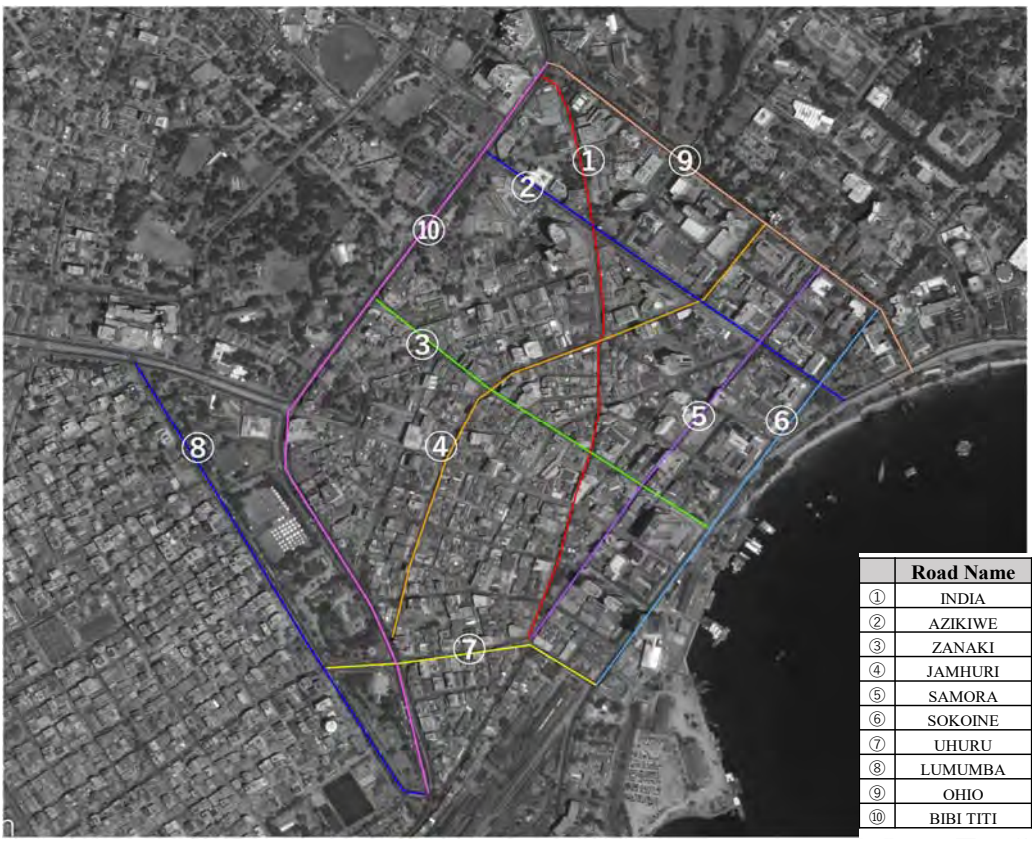
Source: JST

Figure 5.2.45 Number of Parking Vehicle by Transport Mode



Source: JST

Figure 5.2.46 Number of Parking Vehicle by Each Road



	Road Name
①	INDIA
②	AZIKIWE
③	ZANAKI
④	JAMHURI
⑤	SAMORA
⑥	SOKOINE
⑦	UHURU
⑧	LUMUMBA
⑨	OHIO
⑩	BIBI TITI

Source: JST

Figure 5.2.47 Survey Location

(6) Result of OD Interview Survey

1) Summary of OD Interview Survey

Summary of OD interview survey is shown in Table 5.2.23. OD matrices are created based on the roadside OD interview results.

2) Average of Number of Passengers

Average number of passengers by type of vehicle is estimated based on the data obtained from OD interview survey as shown in Table 5.2.23.

Table 5.2.23 Average of Number of Passenger

Unit : Passenger per vehicle

M/C	1.8
Car	2.7
Bus	
Medium/ Micro Bus	12.7
Large Bus	53.1
School Bus	27.1
Truck	2.4

Source: JST

5.2.4 Cargo Movement/ Port OD Survey

Cargo movement is captured by truck OD interview survey at seaport gate No.3 (inbound & outbound), gate No.5 (outbound) and gate No.8 (outbound). Truck OD is created based on the truck OD interview results and by using the same OD zone code.

Table 5.2.24 Number of Truck OD Interviews

Survey Point	Number of Truck OD interviews	Number of Truck volumes (6:00-20:00)
Gate No.3 (inbound)	200	502
Gate No.3 (outbound)	197	515
Gate No.5 (outbound)	234	613
Gate No.8 (outbound)	153	234

Source: JST

(1) Freight Surveys by Drivers' Interview

The interview survey for cargo drivers in Logistics Company was conducted. Table 5.2.25 shows Number of Samples.

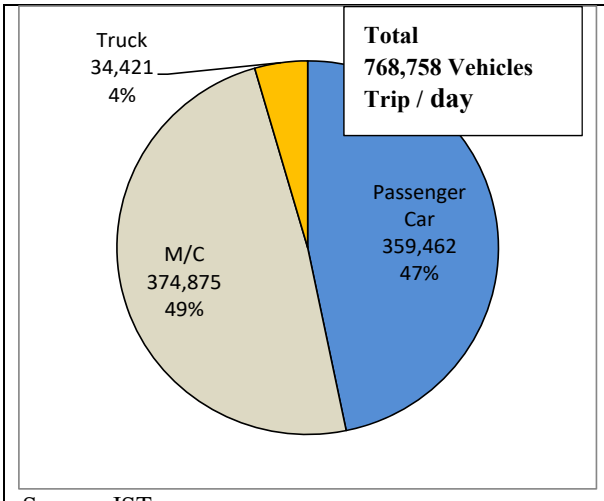
Table 5.2.25 Number of Samples

Number of Company		55
Number of Truck Drivers in above company		1,760
Number of Truck OD interviews		297
Truck Type	2 axels Truck	122
	3 axels Truck	43
	Trailer Truck (4 axels more)	132

Source: JST

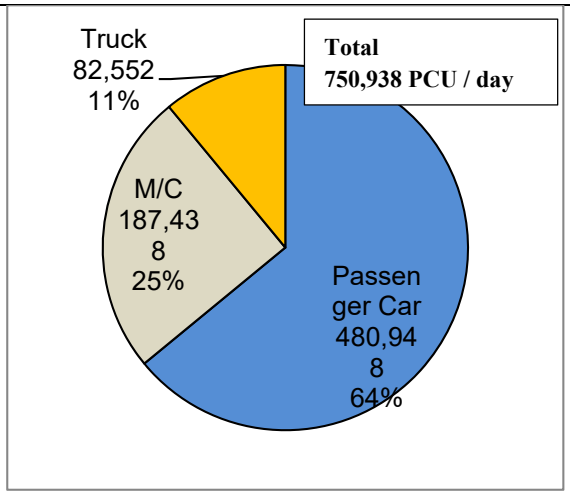
(2) Freight Movement

Truck OD matrices is made from the data including the cordon line survey, port OD survey and freight surveys by drivers' interviews. Total movement of trucks were verified by referring to the result of traffic count survey conducted at same time in January 2017. Truck share in number of total vehicle trips is 4% although the share in PCU is 11%.



Source: JST

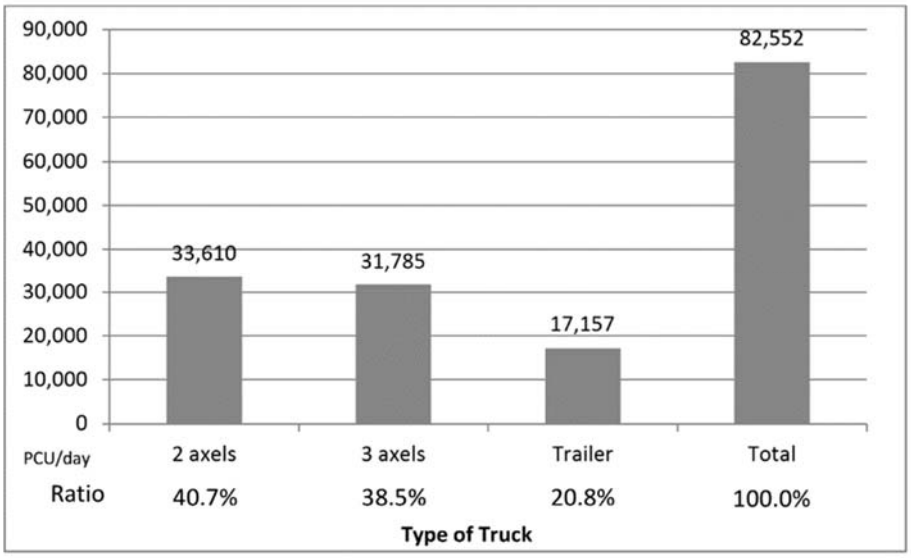
Figure 5.2.48 Truck Share(Number of Vehicles) in 2017



Source: JST

Figure 5.2.49 Truck Share (PCU)) in 2017

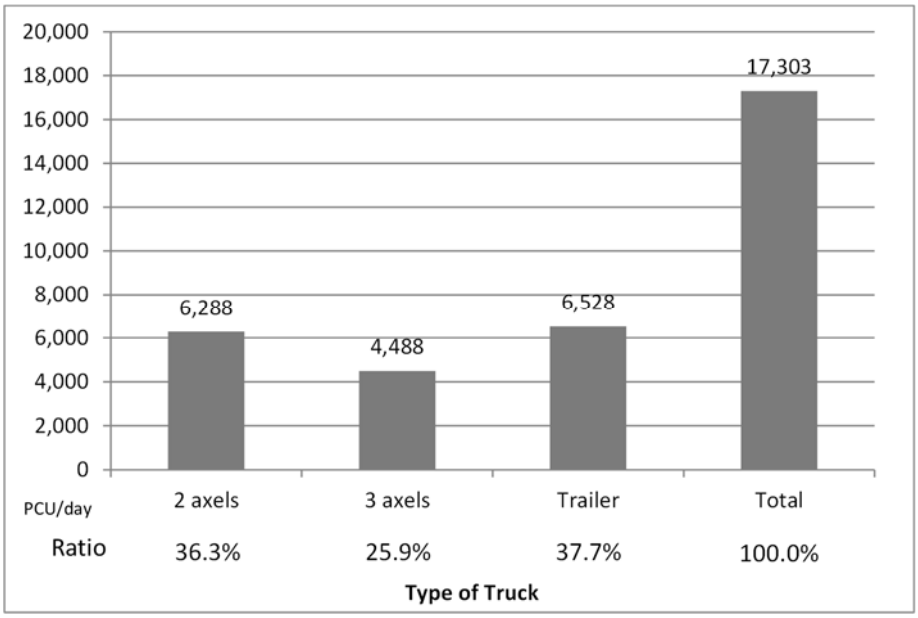
The share of two-axel-trucks in total truck trips is 40.7% and the highest in the three types of trucks.



Source: JST

Figure 5.2.50 Number of Truck (PCU) Generated in 2017

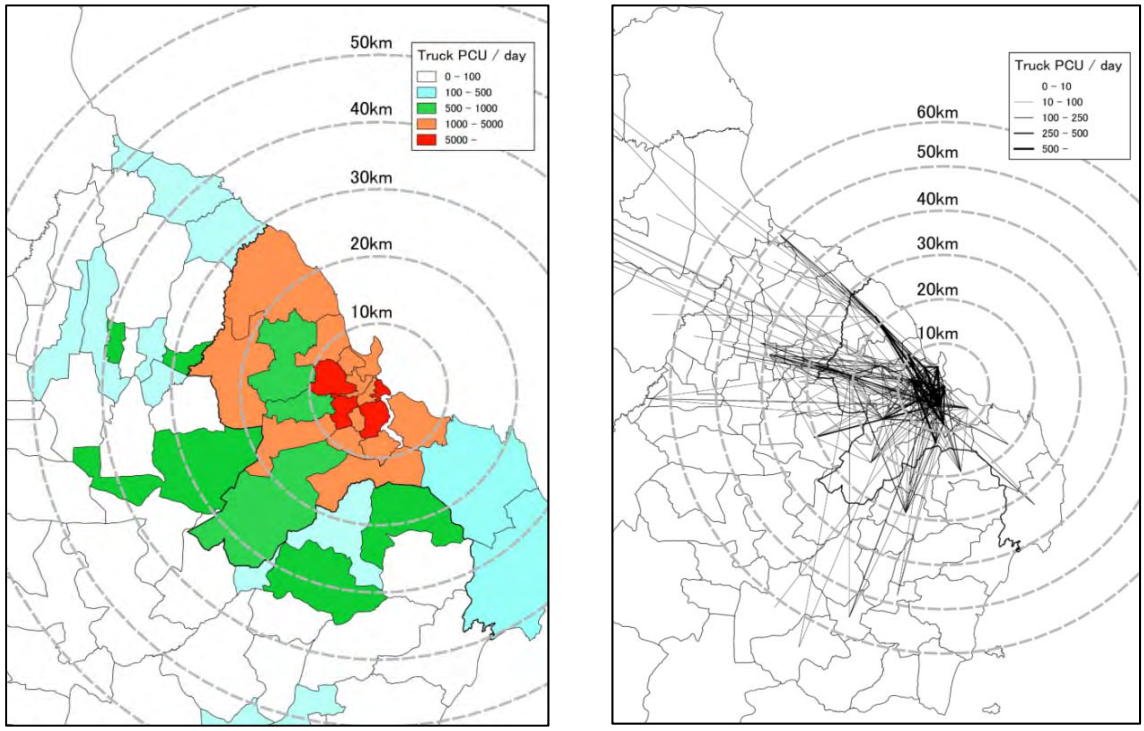
The port zone is the industrial area surrounding the Dar es Salaam port. The port zone has truck trip of 17,303 pcu/day. Its share of the total 82,552 pcu/day truck trips is 20%. The share of trailers in port zone is 37.7% and the highest in three types of trucks.



Source: JST

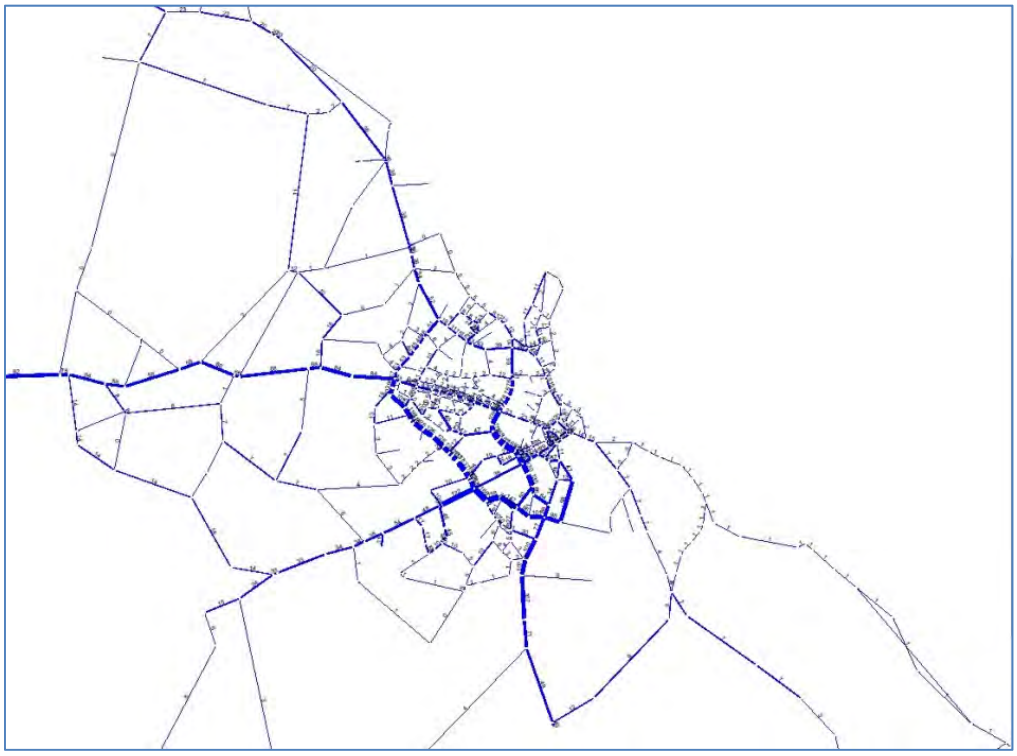
Figure 5.2.51 Number of Truck (PCU) Generated in Port Zone in 2017

Figure 5.2.52 shows the current truck trip generation by each zone and the desired line of truck movement.



Source: JST

Figure 5.2.52 Truck Trips Generation by each Zone (left) and the Desired Line of Truck Movement (right) in 2017



Source: JST

Figure 5.2.53 Current Truck Movement

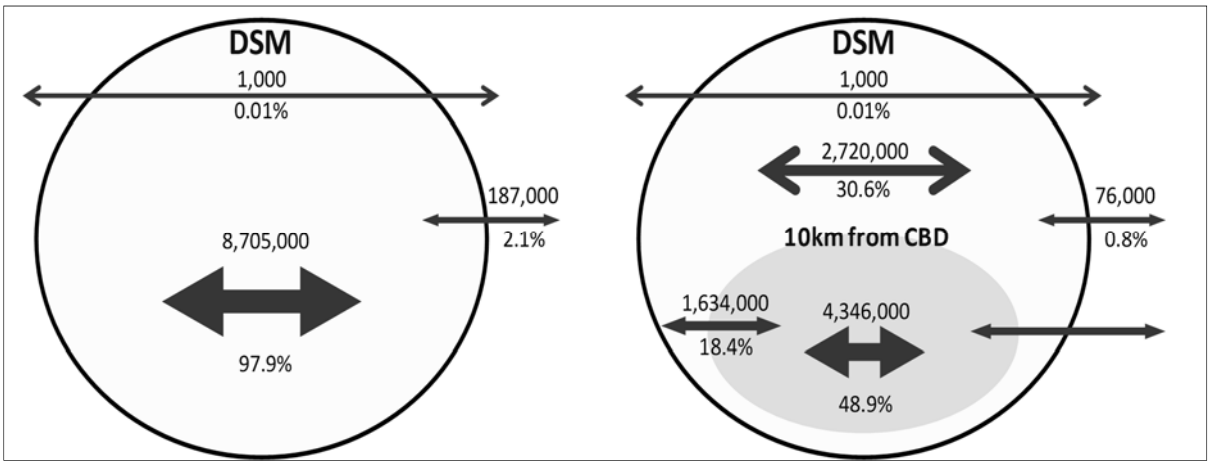
5.2.5 Total Traffic Movement

The total trips related to Dar es Salaam and integrate connected each traffic volume is shown below.

- The trip of Inside DSM: HIS (Person Trip) + Cargo Movement.
- The trip to inside DSM from outside, and the trip to outside DSM from inside: CL (traffic count changed to person trip by average number of passengers.)

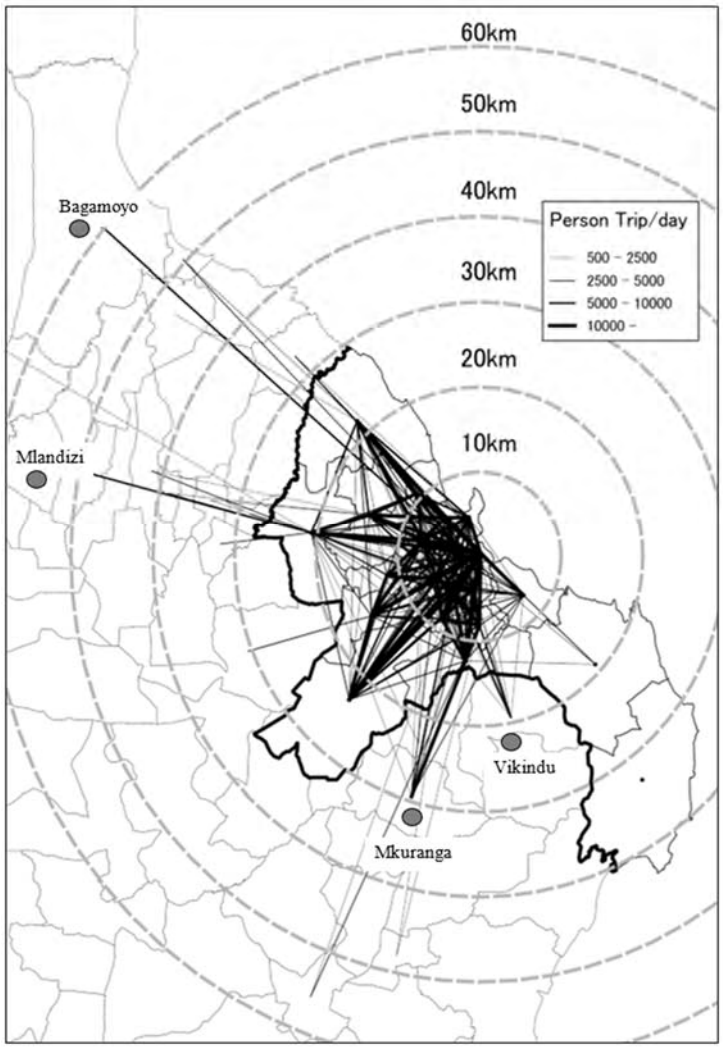
Total Trip Distribution indicates OD table and conceptual diagram of CBD 10km area, inside DSM city, outside DSM city. The total trip related DAM is 8,894,000 trips. The total trip is 50% inside 10km CBD, 98% inside DSM city. The traffic volume of Magomeni, Mlandizi, Vikindu, Mkuranga are large 9in the out of city.

Origin \ Destination		DSM City		Outside	Total
		～10km	10km～		
DSM City	CBD ～10km	4,346 (48.9%)	819 (9.2%)	54 (0.6%)	5,219 (58.7%)
	10km～	820 (9.2%)	2,720 (30.6%)	30 (0.3%)	3,570 (40.1%)
Outside		57 (0.6%)	46 (0.5%)	1 (0.01%)	105 (1.2%)
Total		5,223 (58.7%)	3,586 (40.3%)	85 (1.0%)	8,894 (100.0%)



Source: JST

Figure 5.2.54 Trip Distribution



Source: JST

Figure 5.2.55 Desire Line (All Trips)

5.3 Summary of Current Transport Situation

Followings are the summarization of current transport service and issues, based on the analysis.

(1) Public Transport Service

BRT is very successful as a punctual and speedy mode for commuters. Railway also provides such services although number of operations is limited. BRT can carry people at the operation speed of approximately 20km/h even in peak hours and carry approximately 15,000 passengers per hour per direction in morning peak hour. Therefore, BRT is recognised as a very effective public transport mode in DSM and should have more installed in the trunk routes for commuters from suburb to CBD. However, overcrowded BRTs have already been seen in peak hours. From the view of capacity of transport mode, railway with more capacity than BRT should be installed as well as BRT as a principal commuter mode for the future. In addition, other bus services are poor in suburb due to lack of appropriate road infrastructure for commuter of feeder bus service. Feeder bus operations should be assigned together with the improvement of regional/ commuter /feeder road network.

(2) Road Infrastructure

Roads have been improved through trunk road expansion and new feeder road construction. However, there are currently three major problems identified on the road network: 1) traffic congestion, 2) traffic accident and 3) flood in rainy season. In the past ten years urban areas have been expanding into suburb very rapidly. Road infrastructure should be improved from the view of how to deal with the three problems at the same time under the trend of rapid traffic increase. Nevertheless, it is difficult to catch up to such rapid demand increase by road infrastructure provision. There are several effective measures for the three problems in short term, for example, such as flyover project at heavily congested intersection and introduction of traffic management system in higher traffic demand areas. Such measures should be used more in the future.

(3) Traffic Congestion

According to the results of Home Interview Survey conducted in 2017, private car ownership ratio is estimated to be approximately 11% per household or 33 cars per 1,000 people in DSM. Roughly speaking, the northern area of DSM along Bagamoyo road and Morogoro road is greater in car ownership than the southern area along Nyerere road, Kilwa road and Kigamboni area. So the ratios are still low. As a result of lower car ownership, the modal share of car is low in that the share of car is 6.2% in motorised modes excluding walk and bicycle, whereas the share of public transport modes including bus, BRT, railway and ferry is 85.7%. However, the number of private cars owned by household in DSM increased by 2.44 times between 2007 and 2017. The growth ratio is greater than population growth of 1.90 in the past ten years. Motorisation has been surely proceeding.

Based on the result of the traffic survey conducted in February 2017 by JST, traffic congestion on the road has expanded from CBD to suburbs, in particular on Bagamoyo road. Most of cars on the trunk roads run less than 20km/h in peak hours. It takes more than two hours and a half by car or bus from Bunju to CBD on Bagamoyo road in the morning peak hours. Compared with 2007 road traffic survey data on Bagamoyo road, the traffic demand has grown by 4.3 times on the city boundary, 3.8 times on the Nelson Mandela cordon and 1.2 times on the CBD cordon. The road traffic demand in suburban areas along Bagamoyo road increased more rapidly than other areas. During the period between 2007 and 2017, the population of DSM is estimated to have grown by 1.9 times. It shows that the much higher growth ratio of traffic demand along Bagamoyo road than population increase of DSM was identified.

(4) Traffic Accident and Flood problems

There are 1,626 traffic accidents in DSM in 2016. Most accidents occur along the major road junctions. Traffic safety at intersection will be one of the key issues in the future under the rapid traffic increase. Flood often leads road congestion and traffic accidents in DSM. Therefore, flood problem also defines as one of the important issues on road infrastructure.

(5) Trend of Traffic Demand Increase

As far as the growing traffic demand in DSM in the past ten years is concerned, it can be said that there is a big continuous growing potential because population and car ownership in DSM are predicted to continue to grow in the long run. In particular, the next twenty years until 2040 can

be the very important period whether DSM becomes a city with severely congested roads as a private vehicle dependent city or a city with smooth mobility as a public transport-oriented city.

Table 5.3.1 Indicators of Traffic Demand Growth

Item	2017 Estimated
Population (1,000)	5,782
Household (1,000)	1,226

Item		2017 Survey	2007 Survey	2017/2007
Car Ownership	Population (1,000)	5,782	3,030	1.90
	Number of Car	191,825	78,477	2.44
	Car Ownership ratio (Household)	10.9%	10.0%	1.09
	Number of car (1,000person)	33.2	25.9	1.28
Total Trip (1,000trip/day)		8.674	2.848	3.05
Traffic Volume (Urban Area : Inside Nelson Mandela Road)				
Bagamoyo Road(PCU/day)		50,027	13,117	3.81
Morogoro Road(PCU/day)		46,536	39,613	1.17
Nyerere Road(PCU/day)		48,822	49,215	0.99
Kilwa Road(PCU/day)		52,477	29,135	1.80

Source: JST