Japan-Kenya Urban Development and Transport Symposium

~Challenges facing Kenya urban structure and required measures~

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January 24, 2023

Topics to be addressed

- 1. Urban/Transport Development in Nairobi
- 2. Urban/Transport Development in Mombasa/Northern Economic Corridor
- 3. Results of Impact of JICA Project Ngong Road
- 4. Measures to Improve Urban/Transport Challenges

Location map







Urban/Transport Development in Nairobi

Urban/Transport Development in Nairobi

Characteristics of Nairobi

- Nairobi's development started as a rail depot during Kenya's colonization in **1899.** Later it replaced Mombasa as the new Capital of Kenya in 1907.
- Population: In **1969**, the population was 0.5 M and 50 years later the population is 4.4 M as reported in 2019
- An annual population growth rate of 4.1% (2009-2019)
- Area: 703.9Km²
- Urban challenges: high population density, pollution, and heavy traffic congestion, development pressure to open space.





Nairobi CBD





Traffic congestion along Thika Road

Source: Nation Africa

Standard Media

- 1. Urban/Transport Development in Nairobi
- 1.2 Urban Development Plans

1) Masterplan for colonial capital in 1948

- The plan introduced zones for official buildings, business, and commercial, industry, residential and other uses.
- The area south of the railway station was converted into an extensive industrial zone





2) Nairobi Metropolitan growth strategy 1973

- □ The target year for the plan was 2000.
- Industry area was relocated to suburb and residential area was development surrounding CBD.

- 1. Urban/Transport Development in Nairobi
- 1.2 Urban Development Plans

3) Nairobi Integrated Urban Plan (NIUPLAN)

Urban Challenges:

- Traffic congestion, expansion of informal settlements, and environmental deterioration
- Improving the transport network, infrastructure and utility, and living environment.

NIUPLAN Highlights:

- Promoting the environs to absorb the increasing urban population in "Greater Nairobi"
- A **subcenter system** to divert the heavy concentration of social and economic activities from CBD that causes heavy traffic congestion.

Transport Focus:

- Road Network Development, Hierarchical Classification
- Modal shift to public transport



1. Urban/Transport Development in Nairobi

1.3 Urban Trend

Land Use



- Open area in the eastern part of Nairobi has changed to a developed area
- Open Spaces reduced from 381 sq km (63%) in 2010 to 251 sq km (35%) in 2021
- More high-rise buildings are seen in the western side of Nairobi
- Also, Residential areas converted to commercial in the western side of Nairobi KOEL AFRICA

1. Urban/Transport Development in Nairobi

1.4 Efforts to Improve urban/transport conditions <u>1) Road Network Development</u>

Road network in 2010 (NIUPLAN)





Southern Bypass before

Source: KAF

- Source: MOFLAN
- New road structure: Southern Bypass, Eastern Bypass, Express way
- Road expansion: Ngong Road, West Outer Ring Road, Langata, Outer Ring Road (East), others









Southern **KOEI AFRICA** Bypass

CA Source: Capitalfm.co.ke

- **Urban/Transport Development in Nairobi**
- Efforts to Improve urban/transport conditions

2) Improvement of public bus transport

- Bus Service Improvement: Bus service policy, capacity development to bus operators and regulators for service improvement
- Integrated public transport System: integration of BRT, commuter railway stations, multimodal public transport terminals and other public transport facility plans.
- Four new bus terminals: Green Park, Ngara, Westlands and Makadara have been developed by the Government



New bus terminuses

Source: Kenyans.co.ke



Green Park terminus

Green Park terminus Source: KAF

Source: KAF

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- 1. Urban/Transport Development in Nairobi
- 1.4 Efforts to Improve urban/transport conditions

3) Nairobi Commuter Rail (NCR)

- New Diesel Multiple Units (DMUs)
- Refurbishing of passenger coaches, it has been serving 5 different routes within Nairobi.
- Commuter railway improvement by World Bank (station)

4) Park and Ride

 Station Development to provide parkand-ride services has also been implemented by Kenya Railways along several stations that include Syokimau and Imara Daima stations.



1. Urban/Transport Development in Nairobi

1.5 Urban/Transport Challenges

(1) Road improvement

Achievement

- Road network has been improved through bypass development
- Urban roads have been improved through road expansion

Challenges

- Road improvement can not cope with the demand due to population growth.
- Traffic congestion is observed at the intersections. Traffic control through ITS is necessary.
- Public transport including commuter railway should be strengthened in addition to road improvement.

(2) Public transport improvement

Achievement

- Currently, JICA is supporting a hierarchical public transport network where bus, BRT, and rail shall be integrated
- Bus terminals have been relocated from the Central Business District (CBD)
- Commuter railways operations have been improved (station, track) along some lines

Challenges

- BRT is not operational
- Congestions around the bus terminal area. Bus terminal management and operation should be strengthened
- Commuter railway operation/management needs to be improved (signal, safety, ticketing)
- Public transport (bus, commuter railway) should improve comprehensively and TOD should be applied to improve access and promote sound urban development

Urban/Transport Development in Mombasa/Northern Economic Corridor

Characteristics of Mombasa

- The city was founded in **900 A.D** by the **Arabs** as a trade center. Later in **1593** the Portuguese built **Fort Jesus** to ensure their rule.
- Population: steadily grew from **0.2M** in **1969** to 1.2M in 2019
- Annual growth rate averaging to 2.5% (2009-2019).
- Smallest County with total area of 229.7km²
- A tourist attraction town with beautiful sandy beaches and historical buildings
- Currently Mombasa County serves as the "Gateway" of the Northern Corridor, and has been faced with heavy congestion due to large volumes of trucks causing logistics challenges.



Old Port

Mombasa town







buildings

Urban Development Plans 2.2

1) Urban Development Strategy (1971)

- In 1971, an Urban Development Strategy was formulated to support urban development.
- The population was 247,070 in the year 1969 and was projected to be 1,330,000 in the year 2000.

The main proposals in the 1971 Strategy:

- Decentralisation: construction of а transportation network to link the separate areas into an integrated urban complex through bridges, causeways, ferries, and a bypass.
- Port Expansion with rail access to the Mainland South to enable growth in the south.
- Direct transport linkages between mainland areas and Islands through bridges, causeways, and ferries, and bypasses



2.2 Urban Development Plans

2) Mombasa Gatecity Master Plan(MGCMP)



Development Vision - "A premier gateway port city that upholds diversity and heritage."

- Northern Economic Corridor links are strengthened and logistics and local transport are separated.
- The structure plan was adopted to ease the pressure on Mombasa Island and create access between Mombasa Island and the mainland and control the development in the mainland.
- The sub-centers selected were; Mombasa Island (Main Centre), Bamburi, Mwakirunge (Eco-City), Mtongwe/Likoni (Petro City, Dongo Kundu (SEZ), and Changamwe/Miritini

2.3 Efforts to Improve urban/transport conditions in Mombasa

1) Road Development

Focuses on logistics and transport improvement in a Mainland West.

- Port development: Container terminal
- Road development:
 - Nyali bridge (1980): connect island with Mainland North which accelerated tourism, commercial and residential development
 - Kipevu Link: improve access of port and Northern Corridor
 - Inter change improvement: improve access to port





Changamwe Interchange



Mombasa port

Source:

Kenvans.co.ke

Source: KAF

2.3 Efforts to Improve urban/transport conditions in Mombasa

2) Traffic Management



Port-related traffic congestion

Source: CitizenDigita



Source: KeNHA

- One-way operation
- ITS/intersection improvement



Source: KURA, KeNHA and Mombasa County Government (Current project status)

Note: Mombasa Port Area Road Development = Southern Bypass

2.6 Urban/Transport Challenges in Mombasa/Northern Corridor

(1) Road improvement

Achievement

- Road development has improved the traffic condition, particularly logistics traffic generated form the port (Kipevu link, Makupa causeway, intersection improvement (flyover, underground path)
- SGR contributes to option of transport mode (truck, rail)

Challenges

- Transport improvement measure (one-way, happy hour) has not contributed much to improve traffic management. Non structural measures should be strengthened.
- Traffic control through ITS is necessary.

(2) Public transport improvement

Achievement

• There has not been measure efforts to improve public transport management

Challenges

 Public transport, including existing public transport management (Matatu, Tuk tuk), introduction of new public transport mode, should be improved.

- **Results of Impact of JICA Project Ngong Road** 3.
- 3.1 **Characteristics of Ngong Road**
 - Initially Ngong road was a single carriageway 2-lane road with heavy traffic congestion and large numbers of accident cases.
 - East-West artery road connecting CBD with west part of Nairobi.
 - The road **improvement** works by **JICA** where an upgrade to 4-lane dual carriage way that included dedicated cyclists' and **pedestrians**' section started in 2015





Single Carriageway

Ngong rd Dual Carriageway

- 3. Results of Impact of JICA Project Ngong Road
- **3.1** Characteristics of Ngong Road

Safety Improvements included:

- New Traffic lights
- Street Lights
- Zebra Crossing sections
- Median construction to separate traffic flow (Dual Carriage way)



Ngong Road Before

Source: foursquarecity guide Ngong Road After

Source: nairobiw



- Paved Cyclist lane
- Dedicated pedestrian walkways
- Guard rails at busy road sections to prevent pedestrian crossings at undesignated sections.

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Ngong Road Before

Source: foursquarecity guide Ngong Road After

- 3. Results of Impact of JICA Project Ngong Road
- 3.2 Methodology
 - Accident and Crime data: Police Occurrence Books were used
 - User Perception Survey: Digital Questionnaires issued in every 1km chainage were conducted
 - Traffic Volume: Along major Ngong road intersections, cameras were installed to monitor both weekend and weekday traffic volumes for 24 hours.
 - > Drive Speed: GPS speed differential sensors were used to measure driving speed
 - > Air Quality: Mobile air quality sensors were used to detect pollution levels
 - Light Intensity: Mobile Light-Dependent-Resistors were used to monitor street light intensity along the road
 - Footpath Width: Width of walkways were measured using tapes

3.3 Accidents

Daytime accidents

Night time accidents

Ngong road								
Year	2010	2013	2016	2019	2021			
Daytime accidents	423	236	488	392	322			
Night time accidents	179	132	275	249	209			
Western Ring Road								
Davtime accidents	2010	2013	2010	2019	2021			
Night time accidents	30	<u> </u>	184	154	 14			
Argwings Kodhek Road								

192

104

121

59

299

141

337

188

164

92

ACCIDENT CHANGE OVER THE YEARS



- A Reduction in accidents was observed along Ngong road after its improvement from 2016 to 2021. Installation of traffic lights and separation of Motorized/Non-Motorized transport may have contributed to the reduction in accidents.
- Most accidents in 2016 were caused by *failure to give way* in intersections.
- **Road Safety awareness/education** is necessary to promote the safe use of the roads.

3.4 Crime

	Ngo	ng road								
	2010	2013	2016	2019	2021		→ Ngong roa	ad 🗕 Wes	tern Ring road	📥 Argwings K
Daytime incidences	53	159	81	29	8	100				
Night time incidences	11	50	34	9	6	90				
						00				
	Nesterr	n Ring roa	ad			80				
	2010	2013	2016	2019	2021	70				
Daytime incidences	28	55	47	35	7	<u>щ</u> 60				
Night time incidences	5	18	16	9	4	UNE 50				
						CH				
Arg	gwings	Kodhek r	oad			_≫ 40				
	2010	2013	2016	2019	2021	30				
Daytime incidences	43	107	65	53	14	20				
Night time incidences	15	50	20	11	5	10			_	
						10	_			
						0				

CRIME CHANGE OVER THE YEARS

2016

- Reduction in crime was observed along all the target roads from 2013 to 2021
- Ngong road had the steepest decline in crime from 2016 (after its improvement) to 2021.
- Nighttime incidences along Ngong road from 2016 to 2019 recorded the sharpest fall by 73.5%. Among the notable improvements by JICA that may have contributed to this was the implementation of clear/wider walkways that were well-lit.

2010

2013

2019

2021

Source: KAF

3.5 User Perception



NMT users gave **positive** feedback that crime levels **reduced** after the construction of Ngong road, and this is also supported by data from the Police.



- Even though zebra crossings are present along Ngong road, illegal crossings were observed because the NMT users do not feel safe crossing at designated points.
- Road user education (motorists/non-motorists) and enforcement are necessary to ensure the proper use of safety facilities.

3.6 Traffic Volume

Total traffic volume was 14,100 PCU/Day (Passenger Car Unit per Day) in 2016 before the completion of Ngong road construction.

On Weekdays in 2022, the highest traffic volumes were observed at the Junction mall area where more than 55,000 PCU/day was observed, and near the Southern Bypass interchange where more than 50,000 PCU/day was observed.

The lowest traffic volumerecorded was in Karen where27,286 PCU/Day was recorded.



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Source: KAF

3.7 Drive Speed

The total average speed along Ngong road was 35.33 km/hr in 2022. Before its expansion, it was 40 km/hr in 2015.

Lower average speeds cause lower pollution if coupled with traffic flow smoothing techniques as highlighted by Matthew Barth and Kanok Boriboonsomsin.

An example of a traffic flow smoothing technique is the use of **Intelligent Transport Systems (ITS).**



Source: Barth, M., & Boriboonsomsin, K. (2008). Real-World Carbon Dioxide Impacts of Traffic Congestion



Nilsson (2004) and Elvik (2013) demonstrated that **lower mean traffic speeds** in response to speed limit reductions result in a **reduced likelihood of casualty crashes**

3.8 Air Quality

1) Carbon Monoxide readings to CBD from Karen

Carbon Monoxide readings by the air quality sensor system were mapped





Source: United States Environment Protection Agency

3.9 Air Quality

2) Carbon Monoxide readings to Karen from CBD

- Carbon monoxide readings were the highest near/at the intersections. (between 75 ppm and 150 ppm and can cause impaired mental function after 2 to 6 hrs of exposure)
- At the intersections, there are sudden accelerations and decelerations to cross safely that contribute to pollution. In a similar study conducted by Matthew Barth and Kanok Boriboonsomsin, emissions can be reduced by as much as almost 45% if traffic flow is smoothed to a steady-state condition.
- Installation of ITS systems as a measure of smoothing traffic movement can contribute to reduced emissions.



3. Results of Impact of JICA Project – Ngong Road 3.10 Light Intensity

Previous studies (S Fotios et al) indicate that "a minimum photopic illuminance of 1.0 lux is sufficient light for pedestrians of all ages to safely detect and avoid trip hazards

Street light illumination along the target roads was mapped.

Areas with > 1.0 lux – well lit

Areas with < 1.0 lux – not well lit

From the Junction mall towards Karen, the section is poorly lit with no street light infrastructure available Street illuminance readings to Karen from CBD



3. Results of Impact of JICA Project – Ngong Road
3.11 Footpath Width

Footpath width along the target roads was established

Effective Walkway Width (Meters)	Classification
0 - 1	Very Poor
1 - 2	Poor
2 – 3.5	Good
> 3.5	Very Good

Ngong road is in good/very good condition from the City Mortuary area to Junction Mall, but some improvement is required between the Southern bypass junction to Karen.



Source: KAF

3. Results of Impact of JICA Project

3.12 Land Value Along Ngong Road

Overall, the property values (for both vacant land and properties) along Ngong Road have changed positively between 2015 and 2022, with the greatest change happening in Dagoretti Corner and Ngong.

This finding could be explained by the fact that the Nairobi section already had an established road network; hence the expansion of Ngong Road had little effect on enhancing accessibility and surrounding property values.

Property Type	The area	Average Property	Average Property	Difference	Percentage	
	along Ngong	Values in 2022	Values in 2015	(KES)	Value Change	
	Road	(KES)	(KES)		(%)	
Vacant land	Upper Hill	494,800,000	473,500,000	21,300,000	4.5%	
Vacant land	Dagoretti	405,000,000	335,000,000	70,000,000	20.9%	
	Corner					
Vacant land	Embulbul/V	92,000,000	78,200,000	13,800,000	17.65%	
	et, Ngong					
Average land va	lue change					
along Ngong Road		330,600,000	295,566,667	35,033,333	11.85%	
One-bedroom	Upper Hill	9,750,000	8,800,000	950,000	10.80%	
Apt.						
Two-bedroom	Upper Hill	11,500,000	10,000,000	1,500,000	15%	
Apt.						
Three-	Upper Hill	15,500,000	13,500,000	2,000,000	14.81%	
bedroom Apt.						
One-bedroom	Dagoretti	6,750,000	5,800,000	950,000	16.38%	
Apt.	Corner					
Two-bedroom	Dagoretti	8,500,000	7,500,000	1,000,000	13.33%	
Apt.	Corner					
Three-	Dagoretti	10,000,000	8,800,000	1,200,000	13.64%	
bedroom Apt.	Corner					
One-bedroom	Embulbul/V	4,300,000	3,800,000	500,000	13.16%	
Apt.	et, Ngong					
Two-bedroom	Embulbul/V	6,000,000	5,000,000	1,000,000	20%	
Apt.	et, Ngong					
Three-	Embulbul/V	8,700,000	7,000,000	1,700,000	24.29%	
bedroom Apt.	et, Ngong					

Average property value change along Ngong Road El AFRICA

15.71%

3.13 Summary of Results

- Improvement of traffic congestion together with safety and security
 - Median Separation has deterred NMT users from walking along the road medians. This has aided in improving the safety and security of its users and should be adopted within road design manuals.
 - Street lighting along the roads also contributed to the improved safety and security of its users. Nighttime accidents were reduced by 73.5% from 2016 up to 2021 after the implementation of streetlights.
- Promoting safety and security will contribute to improve traffic
 - Improving public safety through adopting the design of Ngong Road will have a significant impact on reducing traffic congestion by eliminating unnecessary vehicle trips, as people use more non motorized transport mode.
 - Further improve attractiveness of the city through improvement of traffic congestion, safety and security.

Measures to Improve Urban/Transport Challenges

4. Measures to Improve Urban/Transport Challenges

- 4.1 Nairobi
- Road network and safety improvement:
 - Circumferential/radial routes proposed should continue to form improve road condition.
 - Road safety measures be implemented both physical and non-physical.
- Intelligent Transport Systems (ITS): ITS can improve operations at intersections and reduce vehicle waiting times and pollution levels.
- Bus management improvement: bus management policy, bus operation management, service improvement (access, safety), bus terminal, cashless ticket system, TOD.
 - Measures for transport improvement also benefits Matasu operation through which efficiency, safety, access will improve.
- Commuter railway improvement: station improvement system improvement, safety improvement, ticket system improvement, TOD (Line 1, along Ngong Road)



- 4. Measures to Improve Urban/Transport Challenges
- 4.2 Mombasa/Northern Economic Corridor

Improvement of Road Linkage and safety

- Implementation of the Northern Bypass and the Bamburi missing link will ease traffic movement to strengthen road network in the coastal area.
- Intersection should be improved to improve traffic flow.
- **Traffic management measures** through implementation of ITS should be realized.

Improvement of Transport Management

- Suitable public transport modes in Mombasa should be studied in detail. Currently, feasibility studies for BRT development are underway.
- New mode of public transport (e.g. LRT) should be considered to improve local transport.



Source: KURA, KeNHA and Mombasa County Government (Current project status)

Thank you for the kind attention