MINISTRY OF INFRASTRUCTURE, PUBLIC WORKS
AND RECONSTRUCTION
DEMOCRATIC REPUBLIC OF THE CONGO

Project for Urban Transport Master Plan in Kinshasa City -PDTK-

FINAL REPORT

Volume 1: Urban Transport Master Plan in Kinshasa City

April 2019

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
INGEROSEC CORPORATION
YACHIYO ENGINEERING CO., LTD.
ASIA AIR SURVEY CO., LTD.

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Final Report: Volume 1
Urban Transport Master Plan in Kinshasa City

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General Abbreviations

No.	Abb.	English	French
1	AASHTO	American Association of State Highway and Transportation Officials, United States	Association américaine des représentants des administrations des autoroutes et des transports, États-Unis
2	ACCO	Association of Congo Drivers	Association des Chauffeurs du Congo
3	ACE	Congolese Environment Agency	Agence Congolaise de l'Environnement
4	ACGT	Congolese Agency of Great Works, MITPR	Agence Congolaise des Grands Travaux, MITPR
5	ACT	Articulated Truck	Camion articulé
6	AFD	French Development Agency	Agence Française de Développement
7	AfDB	African Development Bank	Banque Africaine de Developpement
8	AGT	Automated Guideway Transit	Transports guidés urbains automatiques
9	AIP	Agro-Industrial Park	Parc Agro-Industriel
10	ANAPI	National Agency for Promoting Industry	Agence National des Promotions de l'Industrie
11	ANIPTMC	National Association of Owners of Motorcycle Taxies of the Congo	Association Nationale des Initiateurs et Propriétaires des Taxis-Motos du Congo
12	AOTU	Urban Transport Authority	Autorité Organisatrice de Transports Urbains
13	APVCO	Association of Public Transport Vehicles Owners	Association des Propriétaires de Véhicules Affectés au Transport en Commun
14	AU	African Union	Union Africaine
15	BADEA	Arab Bank for Economic Development in Africa	Banque Arabe pour le Développement Economique en Afrique
16	BCC	Central Bank of the Congo	Banque Centrale du Congo
17	BCR	Building Coverage Ratio	Coefficient de Couverture de Bâtiment
18	BEAU	Urban planning office	Bureau d'Etude d'Aménagement Urbain
19	BOP	Bottom of the Pyramid	Bas de la Pyramide
20	BRT	Bus Rapid Transit	Bus à Haut Niveau de Service (BHNS)
21	BTC	Technical Control Office, MITPR	Bureau Technique de Controle, MITPR
22	CAGR	Compound annual growth rate	Taux de Croissance Annuel Moyen
23	CAS	Country Assistance Strategy, WB	Stratégie d'aide-pays, BM
24	CBD	Central Business District	Quartier d'affaires
25	CCS-Kin	Kinshasa Southern Growth Corridor, PDTK	Corridor de croissance sud de Kinshasa, PDTK
26	CEI	Independent Electoral Commission	Commission Électorale Indépendante
27	CEPCOR	Support and Monitoring Unit of Regional Programs and Activities of Transport Corridors	Cellule d'Appui et de Suivi des Projets Intégrateurs et des Activités des Corridors des Transports
28	CI	Infrastructure Unit, MITPR	Cellule Infrastructures, MITPR
29	CNPR	National Road Safety Commission, MTVC	Commission Nationale de Prévention Routière, MTVC
30	CNTF	Shipyard and Water Transport (Republic of the Congo)	Chantiers Navals et Transports Fluviaux (République du Congo)
31	COMESA	Common Market for Eastern and Southern Africa	Marché commun de l'Afrique orientale et australe
32	CONADEP	National Driver's License Commission, MTVC	Commission nationale de délivrance des permis de conduire, MTVC
33	CRGM	Center for Geological and Mining Researches	Centre de Recherches Geologique et de Mines
34	CSP	Country Strategy Papers, AfDB	Documents de stratégie pays, BAD
35	CTB	Belgian Technical Cooperation, Belgian Development Agency	Coopération Technique Belge, Agence Belge de Développement
36	DEMU	Diesel-Electric Multiple Unit	Unité multiple diesel-électriqu
37	DEP	Direction of Study and Planning	Direction d'Etudes et Planification
38	DF/R	Draft Final Report	Projet de Rapport Final
39	DMU	Diesel Multiple Unit	Unité multiple diesel
40	DPC	Directorate of Roads and Bridges, MITPR	Direction des Ponts et Chaussées, MITPR
41	DRC	Democratic Republic of the Congo	République Démocratique du Congo
42	DSCRP	Growth and Poverty Reduction Strategy Paper	Document de la Stratégie de Croissance et de Réduction de la pauvreté

No.	Abb.	English	French
43	DSRP	Poverty Reduction Strategy Paper	Documents de Stratégie pour la Réduction de la Pauvreté
44	DT	Director of Transport, Kinshasa City	Directeur des transports, Ville de Kinshasa
45	DVDA	Directorate of Agricultural Roads	Direction des Voies de Desserte Agricole
46	ECCAS	Economic Community of Central African States	Communauté Économique des États de l'Afrique Centrale
47	EDF	European Development Fund	Fonds Européen de Développement
48	EIA	Environmental Impact Assessment	Étude d'Impacts Environnementaux
49	EIRR	Economic Internal Rate of Return	Taux de Rentabilité Interne
50	EMU	Electric Multiple Unit	Unité multiple électrique
51	EU	European Union	Union Européenne
52	F/R	Final Report	Rapport Final
53	F/S	Feasibility Study	Étude de Faisabilité
54	FAR	Floor Area Ratio	Coefficient d'occupation des sols
55	FEC	Federation of Congolese Enterprises	Fédération des Entreprises du Congo
56	FHWA	Federal Highway Administration, US	Administration fédérale des routes, États-Unis
57	FONER	National Road Maintenance Fund	Fonds National d'Entretien Routier
58	GDP	Gross Domestic Product	Produit Intérieur Brut
59	GECT	General of Studies and Technical Advice	Générale d'Etudes et Conseils Techniques
60	GET	Transport Study Group, MTVC	Groupe d'Etudes des Transports, MTVC
61	GIS	Geographic Information System	Système d'Information Géographique
62	GPS	Global Positioning System	Système Mondial de Positionnement
63	GRDP	Gross Regional Domestic Product	Produit Intérieur Brut Régional
64	HGT	Heavy Goods Truck	Camion de marchandises lourdes
65	IC/R	Inception Report	Rapport Initial (R/Ini)
66	ICC	Smart Card (Integrated Circuit Card)	Carte à puce (Carte à circuit intégré)
67	ICCN	Congolese Institute for Nature Conservation	Institut Congolais pour la Conservation de la Nature
68	ICT	Information and Communication Technology	Technologies de l'information et de la communication
69	IDP	Internally Displaced People	Population Déplacés Internes
70	IEE	Initial Environmental Examination	Examen Environnemental Initial
71	IGC	Geographical Institute of Congo	Institut Géographique du Congo
72	IMF	International Monetary Fund	Fonds Monétaire International
73	INS	National Statistical Institute	Institut National des Statistiques
74	IT/R	Interim Report	Rapport intérimaire
75	ITS	Intelligent Transport Systems	Système de transport intelligent
76	JCC	Joint Coordinating Committee	Comité Conjoint de Coordination
77	JICA	Japan International Cooperation Agency	Agence de Coopération Internationale du Japon
78	LDC	Least Developed Countries	Pays les Moins Avancés
79	LGT	Light Goods Truck	Camion de marchandises légères
80	LRT	Light Rail Transit	Transport Léger sur Rail
81	MICE	Meeting, Incentive, Convention and Event/Exhibition	Réunions, Congrès, Conventions et Voyages de Gratification
82	MICS	Multiple Indicator Cluster Surveys, UNICEF	Enquête Par Grappes à Indicateurs Multiples, UNICEF
83	MITPR	Ministry of Infrastructure, Public Works and Reconstruction	Ministère des Infrastructures, Travaux Publics et Reconstruction
84	MTVC	Ministry of Transport and Communications	Ministère de Transport et Vies de Communications
85	NCPI	National Commitments and Policies Instrument	Instrument des engagements et politiques nationaux
86	NEPAD	New Partnership for Africa's Development	Nouveau Partenariat pour le Développement de l'Afrique
87	NGO	Non-Governmental Organization	Organisation non gouvernementale
88	NMT	Non-Motirized Transport	Transport non motorisé
89	NPO	Non-Profit Organization	Organisme sans but lucratif
90	NPV	Net Present Value	Valeur Actuelle Nette
91	NR	National Road	Route Nationale
92	OC	Operation Centre	Centre d'Opérations

No.	Abb.	English	French
93	OD	Origin and Destination	Origine et Destination
94	OJT	On-the-Job Training	Se Former sur le Tas
95	ONEM	National Employment Office	Office National de l'Emploi
96	OPJ	Officer of Judicial Police	Officier de Police Judiciaire
97	OR	Road Agency, MITPR	Office des Routes, MITPR
98	OVD	Office of Roads and Drainage, MITPR	Office des Voiries et Drainages, MITPR
99	PAG	Governance Support Programme	Programme d'Appui à la Gouvernance
100	PANAV	Assistance Program for Navigable Waterways and Lake	Programme d'Appui à la Navigabilité des Voies Fluviales et Lacustres
101	PCR	Road Traffic Police, Congolese National Police	Police de Circulation Routièr, Police nationale congolaise
102	PCU	Passenger Car Unit	Unité de Voiture Particulière
103	PDCA	Plan, Do, Check, Action	Cycle PDCA (roue de Deming), (planifier, faire, vérifier, action)
104	PDNIT	Integrated National Transport Master Plan	Plan Directeur National Integre des Tranports
105	PDTK	Project for Urban Transport Master Plan in Kinshasa City, JICA	Projet d'élaboration du Plan directeur des transports urbains de la ville de Kinshasa, JICA
106	PDU	Urban Development Plan	Plan Directeur d'Urbanisme
107	PG/R	Progress Report	Rapport d'Avancement
108	PLA	Land Development Plan	Plan Local d'Aménagement
109	PNR	Congolese National Police	Police Nationale Congolaise
110	PNSD	National Strategic Development Plan	Plan National Stratégique de Développement
111	PPA	Particular Development Plan	Le Plan Particulier d'Aménagement
112	PPP	Public-Private Partnership	Partenariat Public-Privé
113	PRCMR	Project for Capacity Development on Road Maintenance, JICA	Projet de Renforcement de Capacité de Maintenance Routier, JICA
114	RATPK	Drainage and Public Works, Kinshasa Provincial Government	Régie D'Assainissement et des Travaux Publics, Province de Kinshasa
115	RND	Road Network Density	Densité du Réseau Routier
116	ROW	Right of Way	Droit de passage
117	RRR	Program for the Reunification of the Democratic Republic of Congo by Road	Programme de Réunification de la République Démocratique du Congo par voies Routières
118	RSA	Road Safety Audit	Audit de sécurité routière
119	RVF	Inland Waterway Authority, MTVC	Régie des Voies Fluviales, MTVC
120	SADC	Southern African Development Community	Communauté de Développement d'Afrique Australe
121	SCF	Standard Conversion Factor	Facteur de Conversion Standard
122	SCTP	Commercial Society of Transport and Ports, MTVC	Société Commerciale des Transports et des Ports, MTVC
123	SEA	Strategic Environmental Assessment	Évaluation Environnementale Stratégique
124	SEZ	Special Economic Zone	Zone Économique Spéciale
125	SME	Small and Medium-sized Enterprises	Petite et Moyenne Entreprise
126	SNEL	National Electricity Society	Société Nationale d'Electricité
127	SOSAK	Strategic Orientation Scheme for the Kinshasa Metropolitan Area	Schéma d'Orientation Stratégique de l'Agglomération de Kinshasa
128	SSATP	Sub-Sahara Africa Transport Policy Program, WB	Programme de Politiques de Transport en Afrique Subsaharienne, BM
129	TAH	Trans-African Highway	Routes Transafricaines
130	TAZ	Traffic Analysis Zone	Zone d'Analyse du Trafic
131	TCPK	Container Terminal of Kinshasa Port	Terminal à Conteneurs du Port de Kinshasa
132	TDM	Transport Demand Management	Gestion de la Demande de Transport
133	TEU	Twenty-foot Equivalent Unit	Équivalent Vingt Pieds
134	TOD	Transit Oriented Development	Aménagement axé sur les Transports en Commun
135	TRANSCO	Transport in Congo, MTVC	Transport au Congo, MTVC
136	TVET	Technical and Vocational Education Training	Enseignement Technique et la Formation Professionnelle

No.	Abb.	English	French
137	TWG	Technical Working Group	Groupe de Travail Technique
138	UN	United Nation	Organisation des Nations Unies
139	UNAIDS	Joint United Nations Programme on HIV and AIDS	Programme Commun des Nations Unies sur le VIH/sida
140	UNDP	United Nations Development Programme	Programme des Nations unies pour le développement
141	UNECA	United Nations Economic Commission for Africa	Commission Économique pour l'Afrique
142	UNEP	United Nations Environment Programme	Programme des Nations Unies pour l'Environnement
143	UNHCR	United Nations High Commissioner for Refugees	Haut commissariat des nations unies pour les réfugiés
144	UNICEF	United Nations Children's Fund	Fonds des nations unies pour l'enfance
145	VMS	Variable-message Sign	Panneau à messages variables
146	WB	World Bank	Banque mondiale
147	WHO	World Health Organization	Organisation mondiale de la santé
148	WWF	World Wide Fund for Nature	Fonds mondial pour la nature

Abbreviations for Transport Surveys

No.	Abbreviation	English	French
1	CS	Commuter Survey	Enquête sur les trajets
2	ADS	Activity Diary Survey	Enquête des activités par tenue d'un journal
3	SLS	Screen Line Survey	Comptages par lignes écrans
4	CLS	Cordon Line Survey (Roadside OD Interview Survey)	Enquête par cordons (Enquête OD en bordure de chaussée)
5		Cordon Line Survey (OD Interview Survey at Airport)	Enquête par cordons (Enquête OD sur les voies d'accès à l'aéroport)
6	DTCS	Directional Traffic Count Survey at Intersection	Comptage du trafic par direction aux intersections
7	PS	Parking Survey	Étude sur le parking
8	TGS	Trip Generation Survey	Enquête sur les origines des déplacements
9	TSS	Travel Speed Survey	Étude de mesure des vitesses de circulation
10	SPS	Stated Preference Survey	Enquête sur les motivations latentes
11	RIS	Road Inventory Survey	Inventaire des routes
12	LS	Logistics Survey	Étude des flux de marchandises
13	BUS	Building Use Survey	Étude sur l'utilisation des bâtiments
14	BRS	Bus Route Survey	Enquête sur les lignes de bus

MAIN REPORT

CHAPTER 1 Introduction

1.1 Background and Objectives of the Study

1.1.1 Background

The population of Kinshasa City, the capital of the Democratic Republic of the Congo (hereinafter abbreviated as DRC), has increased from around 2.6 million[1] in 1984 to 10.6 million[2] in 2013 at an average annual growth rate of 4.9% and it is expected to reach around 20 million[3] in 2030 and 26 million[3] in 2040 at the annual growth rates of 3.8% between 2013 and 2030 and 2.7% between 2030 and 2040, respectively.

Twenty one communes out of the total twenty four communes in Kinshasa City are urbanized in terms of such land uses as CBD (Central Business District), commercial, industrial or residential areas where the population density exceeds over 200 persons per hectare in 2013. The urbanized commune area totals about 327 km^2, which accounts for only 3.1 % of the entire area of Kinshasa City that is 10,667 km^2. Meanwhile, the population of the urbanized communes dominates 82.1% of the total Kinshasa City population and they are concentrated excessively to densely built-up communes of over 500 persons/ha, such as Bumbu (1,181 persons/ha), Ngaba (902 persons/ha), Matete (688 persons/ha), N'djili (619 persons/ha), Makala (590 persons/ha) and Ngiri-ngiri (572 persons/ha) in 2013.

Despite the rapid urbanisation of Kinshasa City, current infrastructure development is still insufficient as 80% of total road length still remains unpaved under the jurisdiction of the Office des Voiries et Drainage (OVD / Office of Roads and Drainage). Among the four major arterial roads, Lumumba Boulevard, Congo-Japan Boulevard (*Avenue de Poids Lourds*), Matadi Avenue and 30th June Avenue, the heaviest traffic volume, counted as 35,749 vehicles/12 hours, was observed with frequent traffic congestions on 30th June Avenue. Ordinary bus transport is not well managed since mixed operation of public, private and owner-driven buses prevails, though it was a major means of transport about a decade ago. In addition, the existing three urban railway lines, beginning from the central station toward Kintambo/Kinsuka (West line), Matadi (South line) and the airport (East line), are hardly used. Currently, only a few operations are maintained on the South and East lines in the morning and afternoon due to degradation of the tracks, whereas the West line has stopped its operation at present.

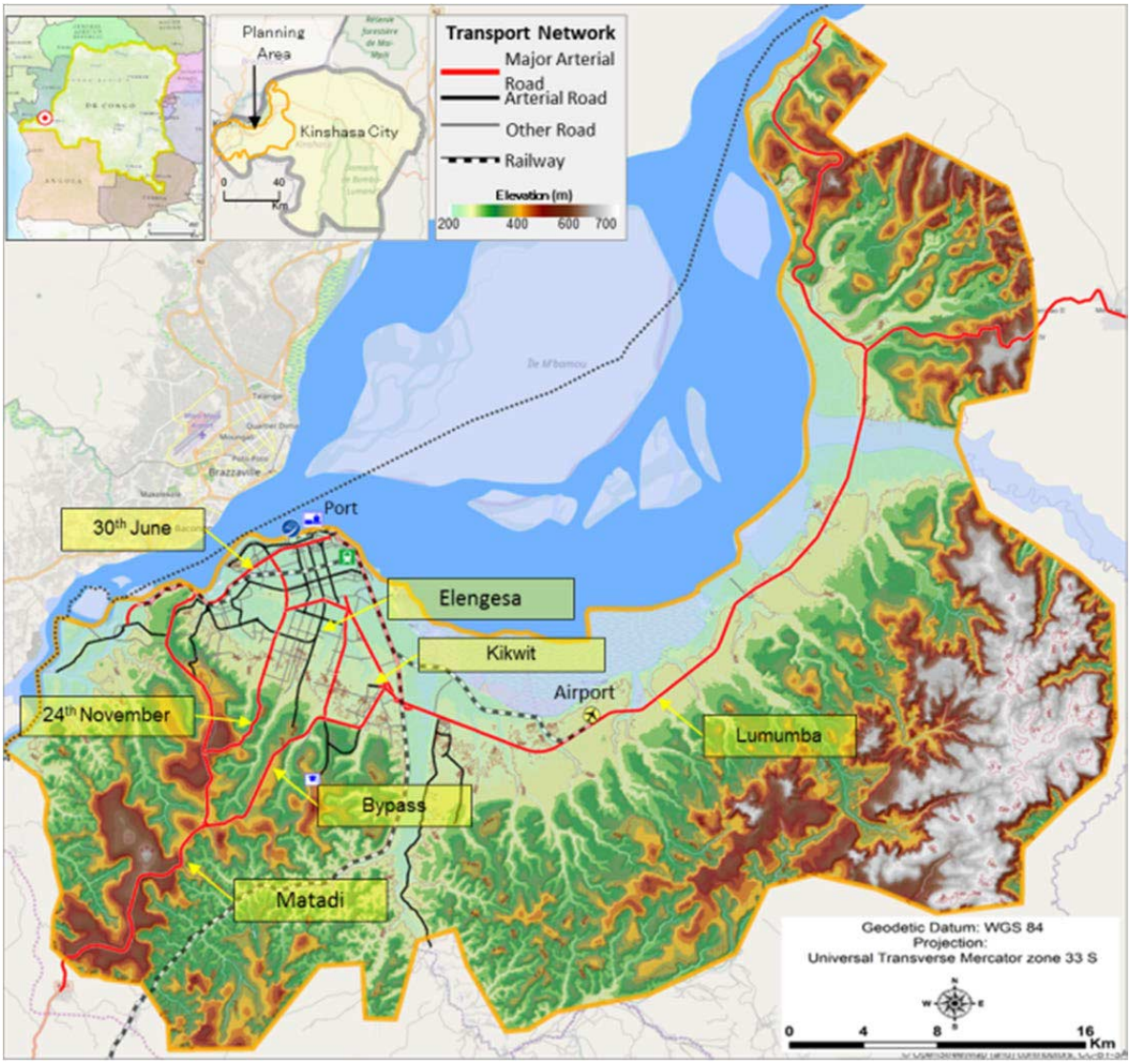
Under the above-mentioned circumstances, SOSAK (*Schéma d'Orientation Stratégique de l'Agglomération Kinoise/* Strategic Orientation Scheme for the Kinshasa Metropolitan Area) has been formulated and formally approved by the provincial congress in 2015 to promote the planned urban development of Kinshasa City with the support of AFD (*Agence Française de Développement* / French Development Agency) which calls for the necessity of Urban Transport Master Plan in parallel with urban development.

[1] Census data in 1984
[2] The estimation of INS (*Institut National des Statistiques* / National Statistical Institute)
[3] The estimation of the Study Team

1.1.2 Study Objectives

The Study aims to contribute to solving the urban transport problems in Kinshasa City by formulating the Urban Transport Master Plan with a middle-term transport infrastructure development programme toward 2030 as the target year, based on a transport demand forecast under a long-term development vision toward 2040. The Study also undertakes a preliminary feasibility study on University Avenue (Pre-F/S).

The Study Area is the urbanised area of Kinshasa City, which covers about 1,450 km^2 out of the total city area of 10,667 km^2, as defined in Figure 1.1.1.



Source: The Study Team

Figure 1.1.1 Study Area

1.2 Scope of the Study

The Study is divided into three phases, they are, Phase 1: Analysis of Current Conditions, Phase 2: Formulation of Urban Transport Master Plan, and Phase 3: Preliminary Feasibility Study for the selected priority projects.

Study tasks included in the respective Study Phases are listed below, and their flow is shown in Figure 1.2.1.

Phase 1: Data Collection and Analysis of Current Conditions (Volume 1)

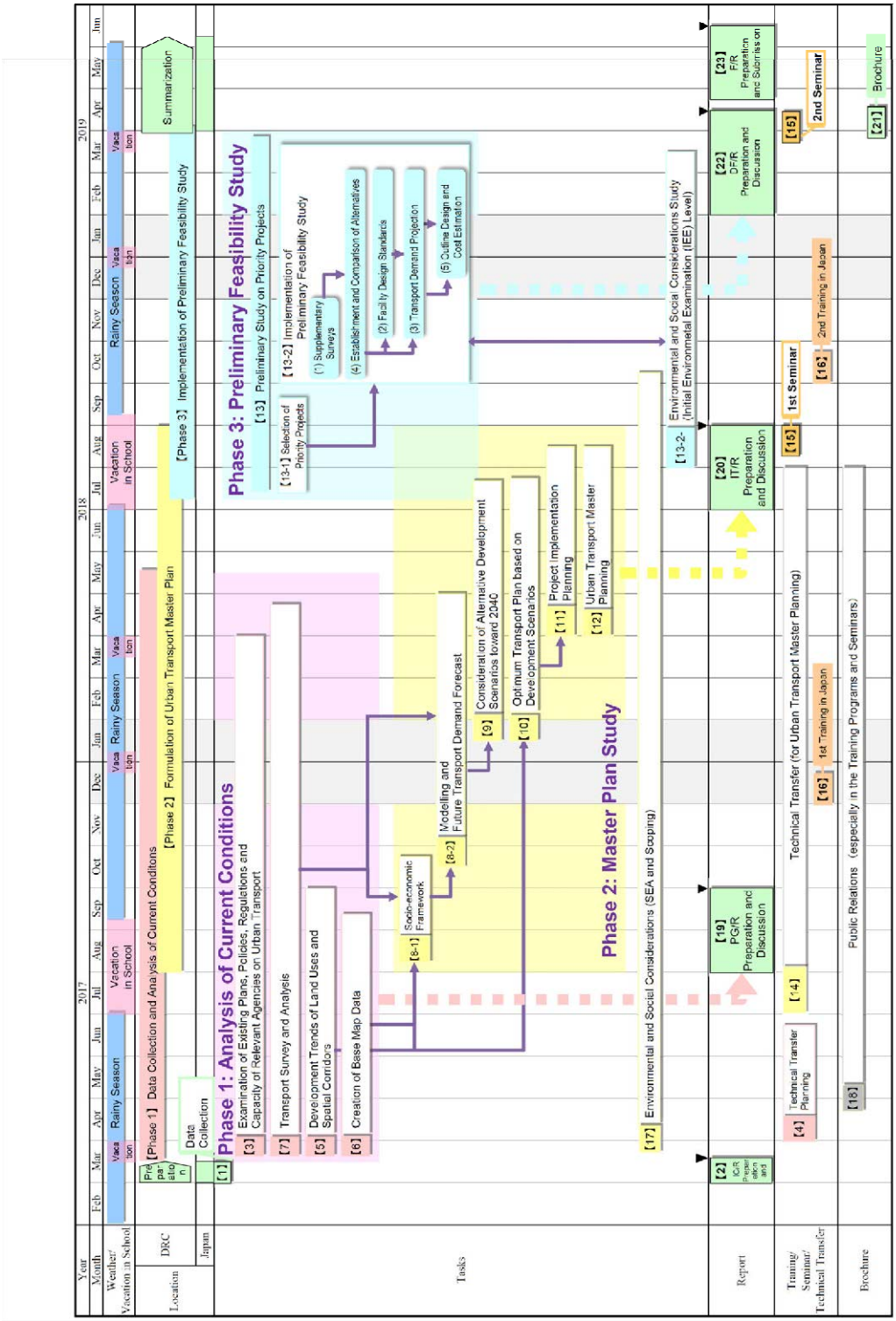
(1) Data Collection and Analysis
(2) IC/R Preparation and Discussion
(3) Examination of Existing Plans, Policies, Regulations and Capacity of Relevant Agencies on Urban Transport
(4) Technical Transfer Planning
(5) Development Trends of Land Uses and Spatial Corridors
(6) Creation of Base Map Data
(7) Transport Survey and Analysis

Phase 2: Formulation of Urban Transport Master Plan (Volume 2)

(8) Future Transport Demand Forecast
(9) Socio-Economic Framework
(10) Modelling and Future Transport Demand Forecast
(11) Consideration of Alternative Development Scenarios toward 2040
(12) Optimum Urban Transport Plan Based on Development Scenario
    a. Public Transport Plan
    b. Road Development Plan
    c. Traffic Management Planning
(13) Project Implementation Planning
    a. Identification of Individual Projects
    b. Project Programmes
    c. Implementation System
(14) Urban Transport Master Planning

Phase 3: Preliminary Feasibility Study on University Avenue (Volumes 2 and 3)

(15) Preliminary Study on Priority Projects
    a. Selection of Priority Projects
    b. Implementation of Preliminary Feasibility Study
(16) Technical Transfer
(17) Seminars
(18) Training in Japan
(19) Environmental and Social Considerations (SEA and Scoping)



Source: The Study Team

Figure 1.2.1 Flow Chart of Study Tasks

1.3 Operation of the Study

1.3.1 Institutional Arrangement for Preparing Urban Transport Master Plan

The institutional arrangement for the Study execution is shown in Table 1.3.1, and the Study Team has been coordinating with these relevant authorities. The MITPR and JICA (Japan International Cooperation Agency) agreed that the CI is primarily in charge of Study execution, and coordinates with relevant authorities through JCC meetings and capacity development efforts.

TWG (Technical Working Group) is established under the JCC for technical discussion. Capacity development is implemented for members of the technical working group, in order to enable them to update the Urban Transport Master Plan in the future.

In addition to the authorities listed in Table 1.3.1, the CI is to invite relevant authorities and organizations as the need arises.

Table 1.3.1 Members and Functions of JCC and TWG (Same as R/D)

	Joint Coordinating Committee (JCC)	Technical Working Group (TWG)
Functions	• To approve work plan, review overall progress • To conduct monitoring and evaluation of the Project • To coordinate among the relevant organisations • To exchange opinions on major issues arising during implementation of the Project	• To work with JICA mission on daily basis and facilitate necessary arrangements for smooth implementation of the Project • To examine and analyse the technical aspects of the Reports • To coordinate and harmonise the stakeholders of the Project and ensure involvement of the concerned authorities • To prepare materials (reports/presentations) for JCC • To correspond to the requests/inquiries made by JCC on technical matters.
Members	Chair (Project Director): Coordonnateur de la Cellule Infrastructures, Ministère des Infrastructures et Travaux Publics <u>Member</u> 1) Conseiller Principal Infrastructures de la Présidence 2) Conseiller Principal au Collège chargé des Infrastructures de la Primature 3) Conseiller Planification, MITPR 4) One representative of Ministère Provincial du Plan, Budget, Travaux Publics et Infrastructures 5) One representative of Ministère Provincial des Transports, Sports, Jeunesse et Loisirs 6) One representative of Bureau d'Etudes d'Aménagement et d'Urbanisme 7) One representative of Office des Voiries et Drainage 8) One representative of Commission Nationale de Prévention Routière 9) One representative of Groupe d'Etudes des Transports 10) One representative of Office des Routes 11) One representative of Société Commerciale des Transports et des Ports	Project Manager: Le Chef de section voiries de la Cellule Infrastructures, Ministère des Infrastructures et Travaux Publics <u>Members of the Democratic Republic of the Congo</u> <u>One expert from the below agencies:</u> 1) Ministère des Infrastructures et Travaux Publics 2) Ministère Provincial du Plan, Budget, Travaux Publics et Infrastructures 3) Ministère Provincial des Transports, Sports, Jeunesse et Loisirs 4) Cellule Infrastructures 5) Bureau d'Etudes d'Aménagement et d'Urbanisme 6) Office des Voiries et Drainage 7) Commission Nationale de Prévention Routière 8) Groupe d'Etudes des Transports 9) Office des Routes 10) Société Commerciale des Transports et des Ports 11) Agence Congolaise de l'Environnement
	Ministère des Infrastructures et Travaux Public may select necessary representatives of relevant ministries and organisations other than indicated above.	

Source: The Study Team

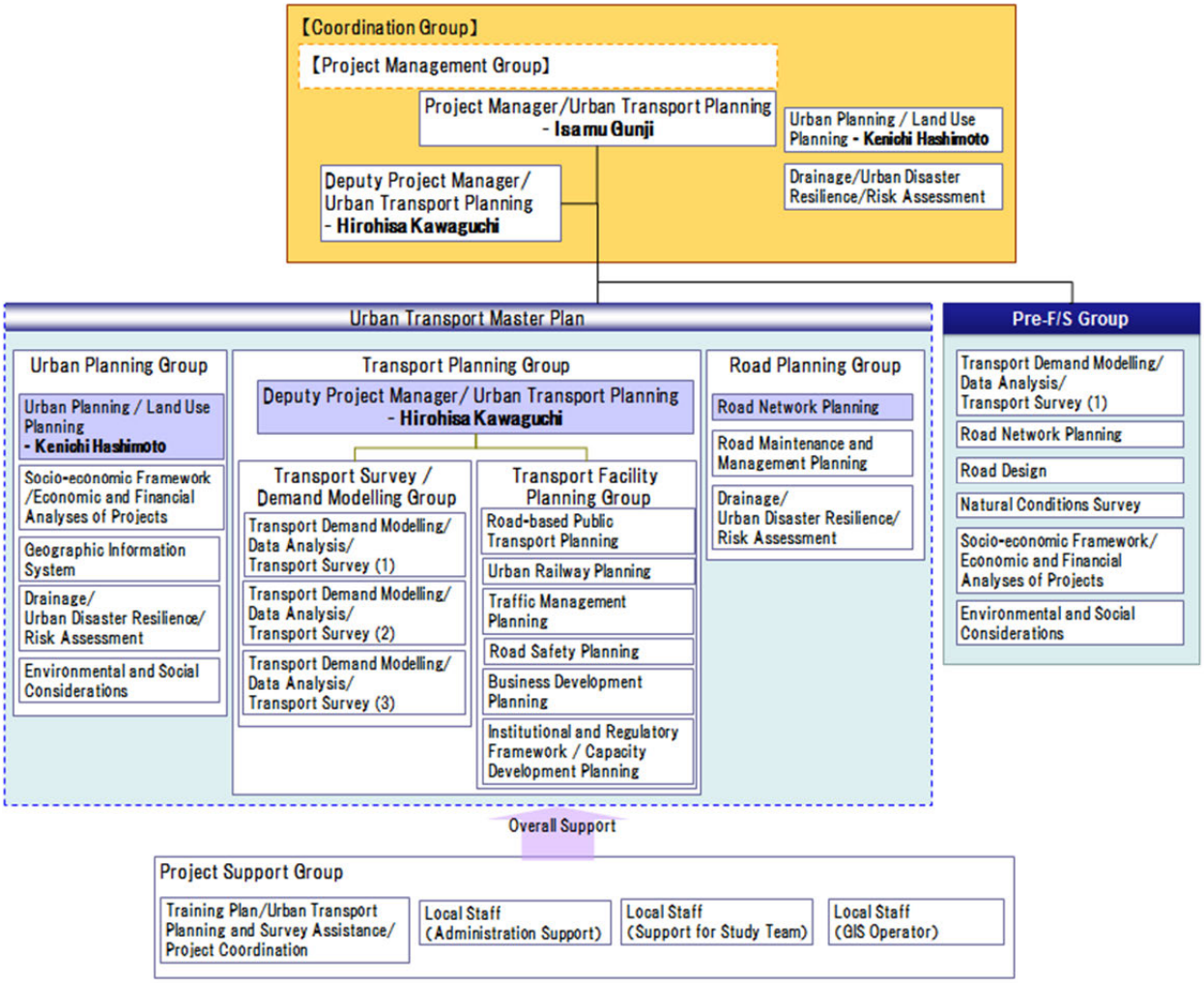
MTVC (*Ministère de Transport et Vies de Communications* / Ministry of Transport and Communications) is overseeing GET (*Groupe d'Etudes des Transports* / Transport Study Group), CNPR (*Commission Nationale de Prévention Routière* / National Road Safety Commission) and SCTP (*Société Commerciale des Transports et des Ports* / Commercial Society of Transport and Ports). The MTVC is also in charge of TRANSCO (*Transport au Congo* / Congo Transport), which operates buses in Kinshasa City. The Study Team, therefore, requested and received

cooperation from the MTVC for collecting data/information on bus, railway, port and road traffic safety policies.

The abovementioned institutions are expected to implement individual projects identified by the Urban Transport Master Plan.

1.3.2 Study Team Members

The organisation of the Study Team is presented in Figure 1.3.1.



Source: The Study Team

Figure 1.3.1 Study Team Organisation

1.4 Contents of the Report

The Study Report consists of three volumes. Volume 1 is on the urban transport master plan for the Study Area corresponding to Phase 1 (Data Collection and Analysis of Current Conditions) and Phase 2 (Formulation of Urban Transport Master Plan) of the Study. Volume 2 and 3 are corresponding to Phase 3, Preliminary Feasibility Study on University Avenue. Volume 2 covers the section from Sendwe IS (Sendwe Intersection) to RP Ngaba (Rond-Point Ngaba / Ngaba Roundabout), namely Section A, and, Volume 3 covers the section from RP Ngaba to University of Kinshasa considering current road network functions as well as availability of open spaces.

Volume 1 of the Draft Final Report consists of 9 Chapters, focusing on data collection and analysis of current conditions (Chapter 2 thorough 4) and preparation of urban transport master plan (Chapter 5 through 9).

1.4.1 Data Collection and Analysis of Current Conditions (Chapter 2 through 4)

Chapter 1: Introduction mainly describes the study objectives, scope of work and introductory statements of the following chapters. It also introduces important issues to be discussed at the 4th JCC meeting that will be held for questions and comments on the Interim Report.

Chapters 2: Transport Survey and Analysis deals with various transport surveys undertaken by the Study, and introduces analytical results of the traffic data collected from the field. The transport survey covered not only the traffic counts, but also interview surveys as listed below:

(1) Commuter Survey (CS)
(2) Activity-Diary Survey (ADS)
(3) Screen Line Survey
(4) Cordon Line Survey (Roadside OD Interview Survey)
(5) Cordon Line Survey (OD Interview Survey at Airport)
(6) Directional Traffic Count Survey at Intersections
(7) Parking Survey
(8) Trip Generation Survey
(9) Travel Speed Survey
(10) Stated Preference (SP) Survey
(11) Road Inventory Survey
(12) Logistics Survey
(13) Building Use Survey
(14) Bus Route Survey

Based on the transport survey results, transport models were built in order to estimate the future transport demand for different models of transport.

Chapter 3: Existing Framework Conditions discusses analytical results of collected data and information on the natural environment, socio-economic conditions, and current land use/urbanization of the Study Area. In addition, it reveals the information derived from the analysis of current development trend and geographical conditions of Kinshasa City, to suggest a direction of planning for the Master Plan preparation. As the prerequisite for the development planning, a necessary knowledge about legal constraints on urban development and SEA

(Strategic Environmental Assessment) that exist in the DRC are exhibited.

Chapter 4: Existing Development Visions, Policies and Plans introduces existing development plans that are most relevant to the Study, such as the PNSD (*Plan National Stratégique de Développement* / National Development Vision and Policy), PDNIT (*Plan Directeur National Integre des Tranports* / National Transport Development Plan) and SOSAK (*Schéma d'Orientation Stratégique de l'Agglomération Kinoise* / Strategic Orientation Scheme for the Kinshasa Metropolitan Area); and which provide the basis to prepare the future framework of urban, transport, social and economic development for Kinshasa City and the Urban Transport Master Plan, eventually.

1.4.2 Preparation of Urban Transport Master Plan (Chapter 5 through 9)

Chapter 5: Vision for Sustainable Spatial Development (2040) discusses for the first time a scale of the urban development required for the growth of the Study Area. Therefore, the future growth of urban population, employment and GRDP (Gross Regional Domestic Product) for the Study Area was investigated referring to the PNSD, PDNIT, SOSAK, INS (*Institut National des Statistiques* / National Statistical Institute) data, UN (United Nation) data and other relevant data and information. Furthermore, a possible orientation and perspectives for Kinshasa City development was examined, in order to envisage Kinshasa City and its macro-economic and social roles in the future.

Chapter 6: Preferred Spatial Development Scenario starts with the examination of the overall scale of the urban development required for the Study Area. Therefore, the balance between the future urbanization pressure (population growth) and available land suitable for the development was examined, revealing that all the potential development area need to be exploited to absorb the estimated future population of the Study Area.

After the recognition of the necessity to develop all the available land for the Study Area, alternative spatial development scenarios were compared, and the preferred one was selected. Based on the selected urban structure, all of the potential area for development was identified with suitable land uses, such as residential, industrial, commercial and other centre developments, following the proposed land use policy and transport development policy.

The Study therefore recommends the preferred urban structure that includes schematic transport network in the Study Area.

Chapter 7: Transport Development Scenario was established by analysing current transport issues, and reviewing existing urban transport policies, plans and projects on the transport network. It also proposes alternative transport scenarios with different modes of transport. The alternative scenarios included such options as “Do Minimum”, “Road-Intensive Road Network” and “Public Transport-Intensive Network”. The “Public Transport Intensive Network” was further specifically divided into “Rail-Intensive” and “BRT-Intensive” alternatives. For the comparison of the alternative scenarios, the overall transport demand and development costs for the respective scenarios were estimated and evaluated to select the most suitable transport scenario for Kinshasa City.

Chapter 8: Urban Transport Sector Plan describes plans identified for such transport sub-sectors as the public transport plan; road development plan; and traffic safety, control and

management plan. The transport sub-sector plans are further elaborated to identify individual projects by different modes of transport or systems.

Chapter 9: Project Implementation Plan for 2030 proposes the implementation schedule towards the target year of 2030, with such priority sequence of Urgent, Short and Medium terms. Issues on financing and institutional enforcement are also proposed, to place those transport projects on a right track for appropriate implementation and to achieve best possible the Urban Transport Master Plan in Kinshasa City.

CHAPTER 2 Transport Survey and Analysis

2.1 Overview

To formulate the comprehensive urban transport master plan for Kinshasa City, robust numerical analysis and evaluation based on a wide variety of transport-related data is essential. With the collaboration of many institutions the Study Team has collected and analysed existing data such as historical statistical data of the DRC (Democratic Republic of the Congo), Kinshasa City, communes and quartiers, as well as the results of past transport surveys.

After analysing the collected data, the Study Team planned and conducted fourteen (14) types of transport surveys to complement and understand the traffic situation in greater detail, including current trip characteristics, traffic volume and transport inventory; and to develop the transport demand forecast model, hereinafter simply referred to as the Transport Model. The objective, method and major findings of each survey are summarized in Section 2.2.

There are two basic approaches to developing a transport model: aggregated and disaggregated. Selecting the best approach will depend on several factors such as project objective, available data, budget, and available time.

The aggregated approach has been in use since the 1950s and there are many examples from around the world. The characteristics of the aggregated approach are zone-based analysis and a simple model structure; however, it requires a large number of samples to develop a reliable model (preferable sample rate is generally 2-3%, though it depends on a size of population) which can lead to high survey costs and long survey periods.

On the other hand, theoretical research on the disaggregated modelling approach started in the 1980s and has since been widely applied in many projects around the world. This approach requires less sampling than the aggregated approach and considers individual characteristics such as age and gender. The disaggregated approach was selected for this study in order to carry out an efficient survey implementation and to allow for the consideration of individual characteristics. The modelling of transport demand projections is summarized in Section 2.3.

2.2 Analytical Results of Transport Survey

(1) Introduction

The fourteen (14) types of survey packages were conducted in the Study. As shown in Table 2.2.1, these surveys results were summarized to 12 types of surveys due to similar characteristics for analysing the objective in the following sections.

Table 2.2.1 Survey Items

Package Name	No	Survey Name	Abbr.
1 Commuter Survey	1	Commuter Survey / Activity Diary Survey	CS/ADS
2 Activity Diary Survey			
3 Screen Line Survey	2	Screen Line Survey	SLS
4 Cordon Line (Roadside OD Interview Survey)	3	Cordon Line Survey (*)	CLS
5 Cordon Line (OD Interview Survey at Airport)			
6 Directional Traffic Count Survey	4	Directional Traffic Count Survey	DTCS
7 Parking Survey	5	Parking Survey	PS
8 Trip Generation Survey	6	Trip Generation Survey	TGS
9 Travel Speed Survey	7	Travel Speed Survey	TSS
10 Stated Preference Survey	8	Stated Preference Survey	SPS
11 Road Inventory Survey	9	Road Inventory Survey	RIS
12 Logistics Survey	10	Logistics Survey	LS
13 Building Use Survey	11	Building Use Survey	BUS
14 Bus Route Survey (BRS)	12	Bus Route Survey	BRS

*The passenger interview and count survey for ship users was conducted under logistics survey considering efficient execution of the field survey.

Source: The Study Team

(2) Survey Objectives

1) Commuter Survey (CS) and Activity Diary Survey (ADS)

The CS and ADS survey aims to understand the commuting characteristics (e.g. work place, school place, transport mode, etc.) of the household members, and to collect the socio-economic attributes of the household and its members.

In addition, the ADS aims to understand the travel behaviours and daily activities (e.g. number of trips in a day, location and time of non-home activity, transport mode, etc.) of the household members.

2) Screen Line Survey (SLS)

The SLS aims to understand the current traffic situation such as traffic volume by vehicle type, peak and off-peak hour, and hourly traffic volume. The annual growth rate can be understood by observing the traffic volume at some of the previous survey locations. In addition, it is used to verify the current OD matrices estimated based on the transport model.

3) Cordon Line Survey (CLS)

The CLS aims to understand trip volume and trip information of passengers in private vehicles and buses on major roads crossing the boundary of the Study Area, and of air passengers departing from N'djili International Airport.

4) Directional Traffic Count Survey (DTCS)

The DTCS aims to understand the current turning movement of vehicles at major intersections, and analyse the cause of traffic congestion within the Study Area. In addition, the data will

constitute parts of the urban transport database, utilized for road projects, and traffic control and management plans.

5) Parking Survey (PS)

The PS aims to grasp demand and supply for parking spaces in the Gombe Commune to suggest traffic management policies such as parking regulation.

6) Trip Generation Survey (TGS)

The TGS aims to understand trip generation by facility type based on measuring how many trips are made from/to the targeted facilities. This data is used to complement the results of the ADS, and trip rates are estimated based on the transport model.

7) Travel Speed Survey (TSS)

The TSS aims to identify congested bottlenecks of main roads and visualize the travel speed by utilizing vehicles equipped with a GPS logger. Observed travel speed information is used for the analysis of the current transport situation with regard to traffic flow, traffic control, and so on.

8) Stated Preference Survey (SPS)

The SPS aims to estimate the demand if a new public transport is introduced. It is necessary to understand people's stated preference (SP) for selecting a new transport mode under hypothetical conditions, which cannot be predicted through the analysis of the existing trip data, and to develop a mode choice model for transport demand forecast.

9) Road Inventory Survey (RIS)

The RIS aims to identify the road characteristics such as width, pavement type, number of lanes, and surface condition. In addition, it is utilized to develop road networks for the transport model.

10) Logistics Survey (LS)

The LS aims to understand current trip patterns and traffic volumes of freight vehicles at their major origins and destinations, such as ports, container terminals and logistics centres.

11) Building Use Survey (BUS)

The BUS aims to understand the number of floors and building use in 6 Communes (Bandalungwa, Barumbu, Gombe, Kinshasa, Kintambo, and Lingwala) to update the land use map prepared by SOSAK and to verify current population.

12) Bus Route Survey (BRS)

The BRS aims to understand current bus operation and passenger volumes. In addition, this database is utilized as the base data to prepare the future public transportation plan.

2.2.1 Commuter Survey (CS) and Activity Diary Survey (ADS)

(1) Survey Method

a) Commuter Survey (CS)

Sample households targeted by the CS were randomly selected based on a satellite image of the Study Area.

Surveyors were dispatched to visit the selected households and conduct face-to-face interviews with their representatives to answer questionnaires on the survey form. The form was designed to collect socio-economic and commuting information of each household member listed in Table 2.2.2.

Table 2.2.2 Survey Contents of Commuter Survey

Form	Contents
Form 1-1: Household Information	- Nationality - Name of Household Head - Location of Household (Address, Longitude and Latitude) - Household Monthly Income and Expenditure - Vehicle Ownership (Car / Motorcycle) - Number of Household Members - Number of Other Households at the same floor
Form 1-2: Personal Information	- Name / Gender / Age - Relationship to Head of Household - Cellular Phone Ownership - Driver's license
Form 2-1: Commuting Information	- Educational Attainment - Social status (Worker, student, retired, unemployed, etc.)
Form 2-2: Student Information	- General Information ・ School Name / Type of Educational Institution ・ Location of School (Address, Longitude and Latitude) - Commuting Attributes ・ Commuting Frequency ・ Departure and Commuting Time (to School / to Home) ・ Transport Mode (to School / to Home) ・ Commuting Expense
Form 2-3: Worker Information	- General information ・ Type of Working Place ・ Location of Work Place (Address, Longitude and Latitude) ・ Company Profile ・ Personal Monthly Income - Commuting Attributes ・ Commuting Frequency ・ Departure and Commuting Time (to Work / to Home) ・ Transport Mode (to Work / to Home) ・ Commuting Expense

Source: The Study Team

During the survey implementation, the surveyors utilized the tablet application developed by the Study Team for efficient survey execution. The utilization of the application enabled them to

acquire precise locations of each household and their commuting places, and record the result of the interviews accurately.

b) Activity Diary Survey (ADS)

The ADS consists of two parts; 1) Commuter Part and 2) Activity Diary Part.

The Commuter Part was conducted by the surveyors in the same manner as that of the CS, including the methodology of the survey implementation and questionnaire.

As for the Activity Dairy Part, targeting the same households as that of the Commuter part, surveyors were requested to deliver paper-based survey forms, to explain how to fill in the forms, to re-visit them and to collect accomplished survey forms by the household members. As shown in Table 2.2.3, the survey form was designed to capture travel behaviour and daily activities of those aged five and up during two continuous weekdays, in fifteen minutes interval.

Table 2.2.3 Survey Contents of Activity Diary Survey

Form	Contents
Commuter Part	- (Same contents as that of the CS.)
Activity Diary Part	- Date and simple Questionnaires of the date - Activities at Home ・ Period of Time ・ Type of Activities ・ Location of the Household (Address, Longitude and Latitude) - Activities Outside ・ Period of Time ・ Type of Activities ・ Location of the Activity(Address, Longitude and Latitude) - Transport Activities ・ Travel time ・ Transport Mode ・ Travel Cost

Source: The Study Team

Source: The Study Team

Figure 2.2.1 Photos of CS and ADS Implementation

(2) Survey Coverage and Sampling

The survey area of the CS and ADS corresponds to the urbanized area in the Study Area, and 24 communes are included.

a) Commuter Survey (CS)

The effective sampling ratio of the CS is set at 0.35 percent within the above-mentioned survey area. The estimated population of Kinshasa City in 2015 was approximately 12 million. Based on the Demographic and Health Survey 2013-14, the average household size of DRC is around 5.3 persons per household, thus the number of households in the region is estimated at 2.26 million households. Therefore, the number of sample households was estimated as approximately 8,000 households assigned in each commune.

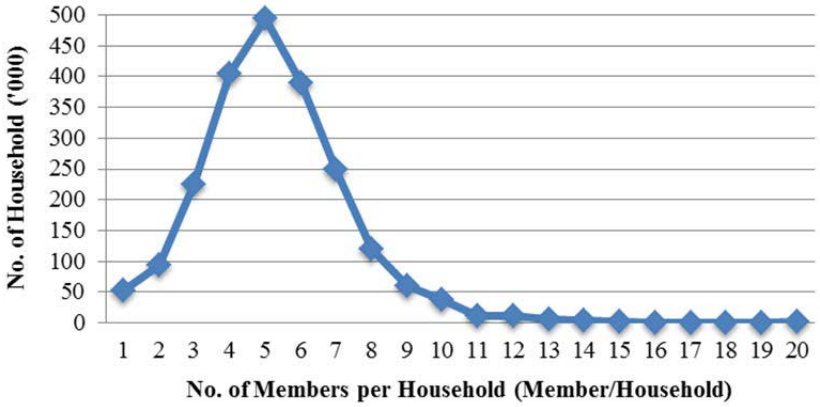
b) Activity Diary Survey (ADS)

The number of sample households for the ADS is set as 1,000 households in consideration of the transport model development.

(3) Basic Analysis and Major Findings

a) Household Features

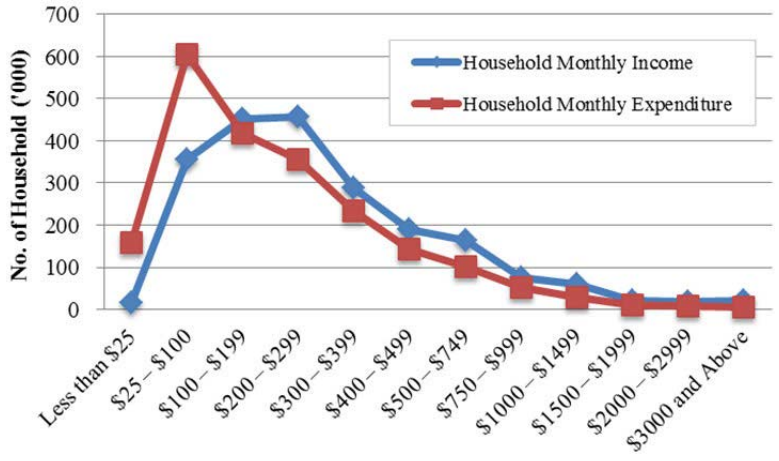
Figure 2.2.2 demonstrates the estimated number of household population by average household size, which means an average number of members per household. The result shows that the average number is 5.29 members per household in the Study Area.



Source: The Study Team

Figure 2.2.2 Household Population by Average Household Size

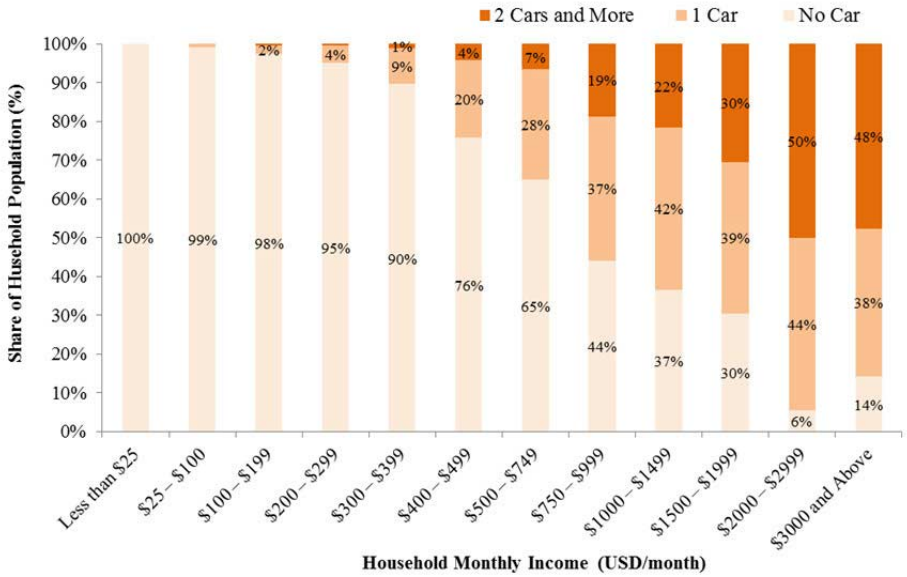
Figure 2.2.3 shows the estimated number of household population by monthly income and expenditure. The shares of the monthly household income and expenditure peak in at the amounts of $200 – $299 and $25 – $100 per month, respectively.



Source: The Study Team

Figure 2.2.3 Distribution of Household Population by Monthly Income and Expenditure

Figure 2.2.4 describes the car ownership rate by household monthly income. The proportional relationship between household car ownership and monthly income is observed. It specifically shows that the share of the household car ownership with monthly household incomes is over USD 750 / month, exceeding 50%. It also shows that almost half of the households with an income of USD 2,000 and over are likely to own more than two cars.



Source: The Study Team

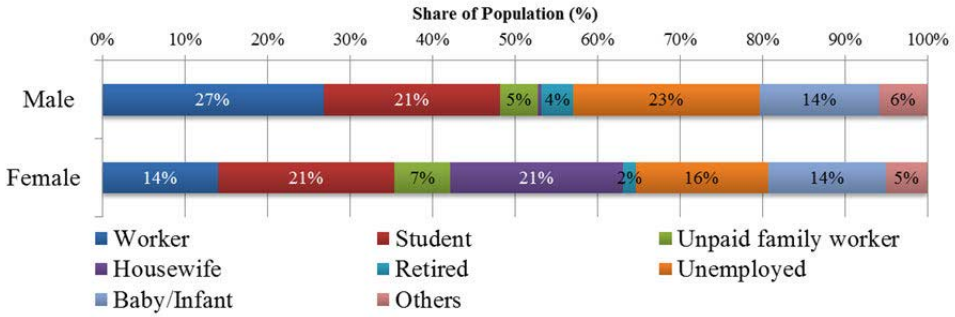
Figure 2.2.4 Car Ownership Rate by Household Monthly Income

b) Demographic Features

Figure 2.2.5 and Figure 2.2.6 illustrate the share of population in social status groups by gender

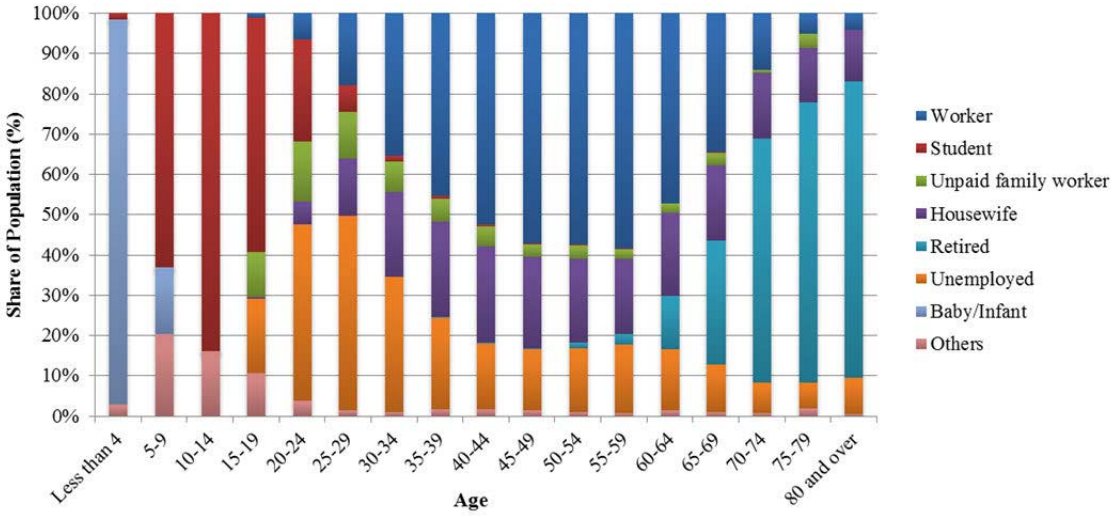
and age groups, respectively. The share of male workers is approximately twice as than that of female workers, while there is almost no gender difference of student shares.

A tendency of the share of social status depending on age groups is observed. It should be noted that almost half of the share of population in the twenties is occupied by "unemployed" as their social status.



Source: The Study Team

Figure 2.2.5 Share of Population by Social Status Group and Gender

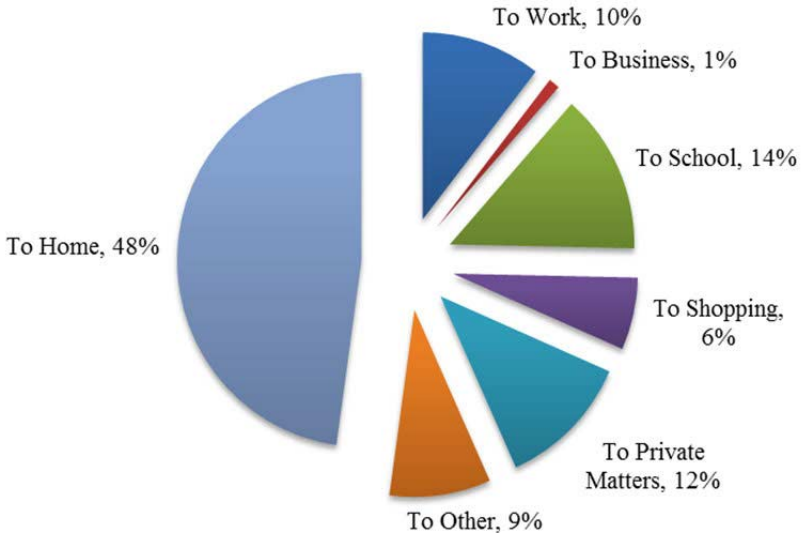


Source: The Study Team

Figure 2.2.6 Share of Population by Social Status Group and Age

c) Trip Purpose

Based on results of the CS and ADS, approximately 18 million trips are generated in the Study Area. The purpose composition of these trips is illustrated in Figure 2.2.7. It shows that a trip to school is the most dominant trip in the Study Area. The shares of trips to school, private matters, work, other, shopping, and business are 14%, 12%, 10%, 9%, 6% and 1%, respectively.



Source: The Study Team

Figure 2.2.7 Trip Purpose Composition in the Study Area

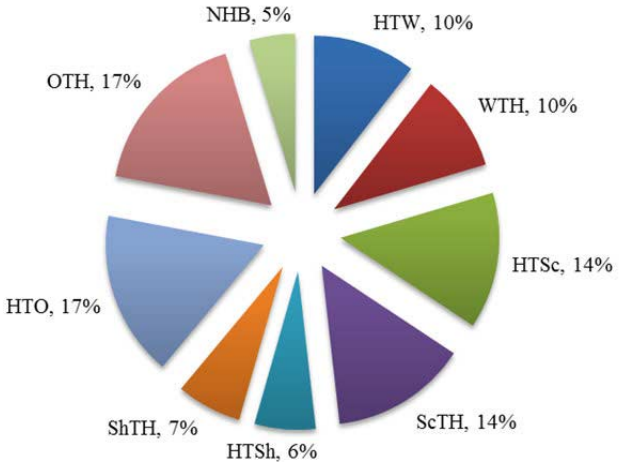
For the transport demand projection, these trip purposes are rearranged into home-based purpose categories based on the origin and destination types. Table 2.2.4 shows the number of the trips by the home-based purpose. It is noted that the trips to private matters and others shown in Figure 2.2.7 are integrated into "Home to Other (HTO) for subsequent analysis. The purpose composition of these home-based trips with their origin type is illustrated in Figure 2.2.8.

The trips for the purposes of Home to Other and Other to Home with their share of 17% respectively are comparatively outstanding. The trips for Home to School and School to Home are the second biggest share of 14%. On the other hand, due to the high unemployment rate in Kinshasa City, the share of the trips for Home to Work and Work to home are significantly limited compared to the major cities of other countries.

Table 2.2.4 Number of Trips by Home-based Purpose

No.	Trip Purpose		Home-based Purpose	No. of Trips ('000)	Share
1	HTW	Home to Work	Home-based Work	1,886	10%
2	WTH	Work to Home		1,786	10%
3	HTSc	Home to School	Home-based School	2,496	14%
4	ScTH	School to Home		2,499	14%
5	HTSh	Home to Shopping	Home-based Shopping	1,121	6%
6	ShTH	Shopping to Home		1,195	7%
7	HTO	Home to Other	Home-based Other	3,034	17%
8	OTH	Other to Home		3,118	17%
9	NHB	Non-Home Based	Non-Home Based	847	5%
Total				17,982	100%

Source: The Study Team



Source: The Study Team

Figure 2.2.8 Home-based Trip Purpose Composition in the Study Area

d) Trip Rate

A trip rate is a significant indicator to determine the amount of trip generation by the residents, and to grasp their travel behaviours in the Study Area. The term "Trip" refers to "linked trip by trip purpose" for the following analysis without any specification.

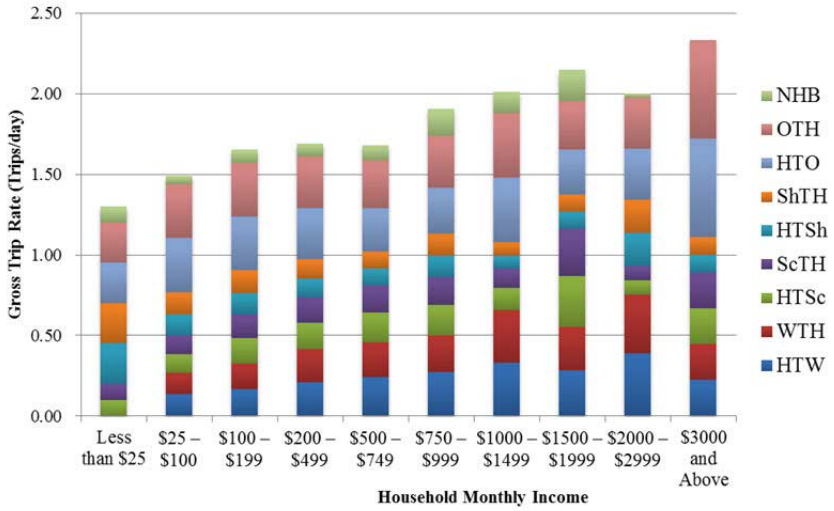
The trip rate is defined as the average number of generated trips per weekday by residents in the Study Area whose age is 5 years old and over. It is categorized into two categories: a gross trip rate and net trip rate. The gross trip rate is calculated based on the total number of residents in the Study Area; the net trip rate is calculated based on the total number of the residents who produced trips in a weekday. Table 2.2.5 shows the gross and net trip rates estimated by the result of the ADS. It indicates that the gross and net trip rates in the Study Area were 1.68 and 2.32 respectively.

Table 2.2.5 Trip Rate and Out-going Ratio

No.	Trip Purpose		Gross Trip Rate	Net Trip Rate	Out-going Ratio
1	HTW	Home to Work	0.20	0.27	
2	WTH	Work to Home	0.19	0.26	
3	HTSc	Home to School	0.16	0.22	
4	ScTH	School to Home	0.15	0.21	
5	HTSh	Home to Shopping	0.12	0.16	
6	ShTH	Shopping to Home	0.12	0.17	
7	HTO	Home to Other	0.32	0.45	
8	OTH	Other to Home	0.33	0.46	
9	NHB	Non-Home Based	0.09	0.12	
Total			1.68	2.32	0.60

Source: The Study Team

Figure 2.2.9 shows the gross trip rates by social status. It illustrates that the number of the trips rates tends to increase in according to household incomes, which appears to be result from the share of home-based work trips increase.



Source: The Study Team

Figure 2.2.9 Gross Trip Rate by Household Monthly Income

e) Transport Mode

Table 2.2.6 and Figure 2.2.10 show the number of trips by transport mode and modal share.

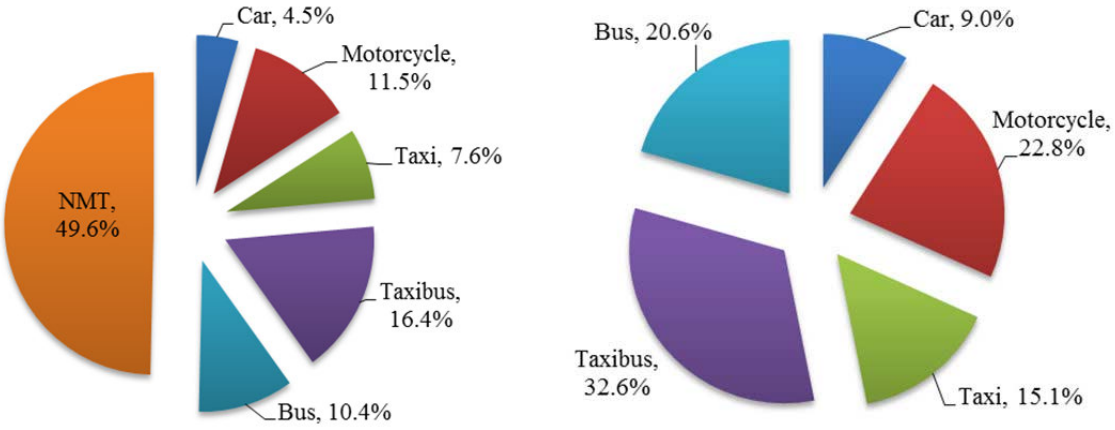
The high dependence on NMT (Non-Motorized Transport) that includes walking and bicycle is exceptional at 49.6%. As for motorized transport, it shows that taxibuses play a significant role in the Study Area, as 32.6% of the all motorized trips depend on the taxibus. This result indicates that the Study Area highly relies on the market-oriented public transport network. On the other hand, the usage of private cars is limited in the Study Area at this time. The share of the car is only 4.5% of all of trips and 9.9% of all motorized trips.

Table 2.2.6 No. of Trips by Transport Mode

No.	Mode of Transport	All Modes		Excluding NMT	
		No. of Trips ('000)	Share	No. of Trips ('000)	Share
1	Car	814	4.5%	814	9.0%
2	Motorcycle	2,064	11.5%	2,064	22.8%
3	Taxi	1,368	7.6%	1,368	15.1%
4	Taxibus	2,950	16.4%	2,950	32.6%
5	Bus	1,862	10.4%	1,862	20.6%
6	NMT*	8,924	49.6%	-	-
Total		17,982	100.00%	9,057	100.00%

*: NMT stands for a non-motorized transport including walking and bicycle.

Source: The Study Team



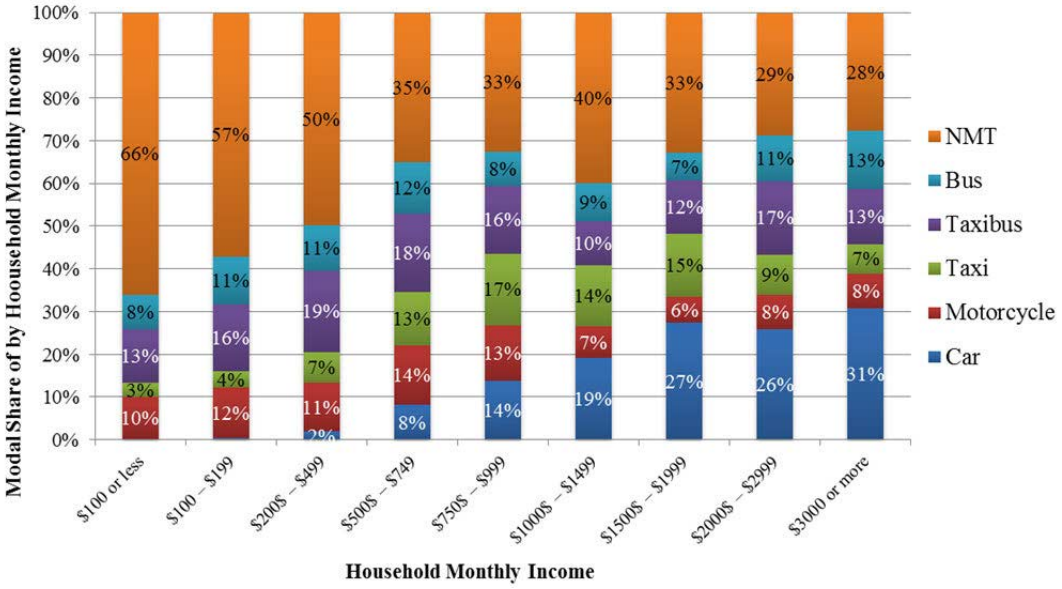
Note: The figures on the left and right are for all transport modes and for modes excluding NMT, respectively.

Source: The Study Team

Figure 2.2.10 Modal Share in the Study Area

Figure 2.2.11 shows modal share by household monthly income. It indicates that the household income significantly influences the modal share.

The share of cars increases in proportion to the income, reaching to almost 30% in the group of the income over USD 3,000 per month. The share of taxies has a similar tendency. In contrast, the shares of NMT and motorcycles tend to decrease depending on the income level. In conclusion, it illustrates that there is not a significant relationship between the income levels and the shares of bus and taxibus, whose modal shares tend to be constant.



Source: The Study Team

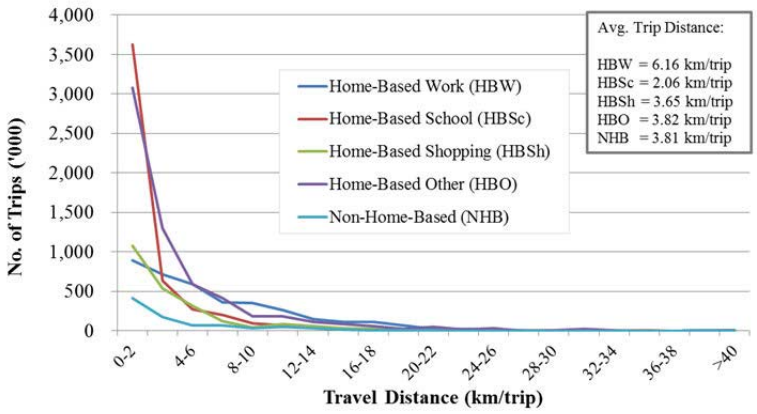
Figure 2.2.11 Modal Share by Household Monthly Income

f) Travel Distance

Figure 2.2.12 illustrates the average travel distance by trip purpose. It shows that home-based work trips have the longest travel distance, at 6.16 km/trip. On the other hand, it reveals that home-based school trips tend to have the shortest distance, at 2.06 km/trip on average.

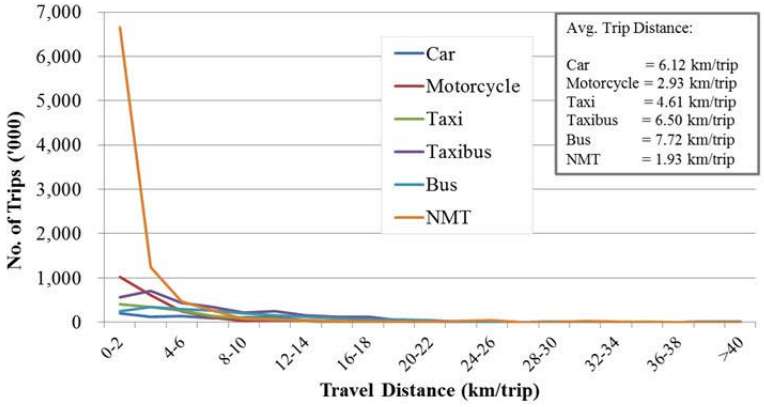
Figure 2.2.13 describes average travel distance by transport mode. It shows that the average travel distance by public transport, including bus and taxibus, has the longest travel distance at over 6.5 km/trip and the average distance by car follows at 6.12km/trip. NMT and motorcycles are modes with shorter distance at almost 2-3km/trip on average.

In addition, the share of trips by NMT tends to decrease sharply in accordance with trip distance of almost 3km/trip. On the other hand, the peak of trips by public transport is observed at around 3-4km/trip.



Source: The Study Team

Figure 2.2.12 Travel Distance by Trip Purpose



Source: The Study Team

Figure 2.2.13 Travel Distance by Transport Mode

g) Trip Production and Attraction

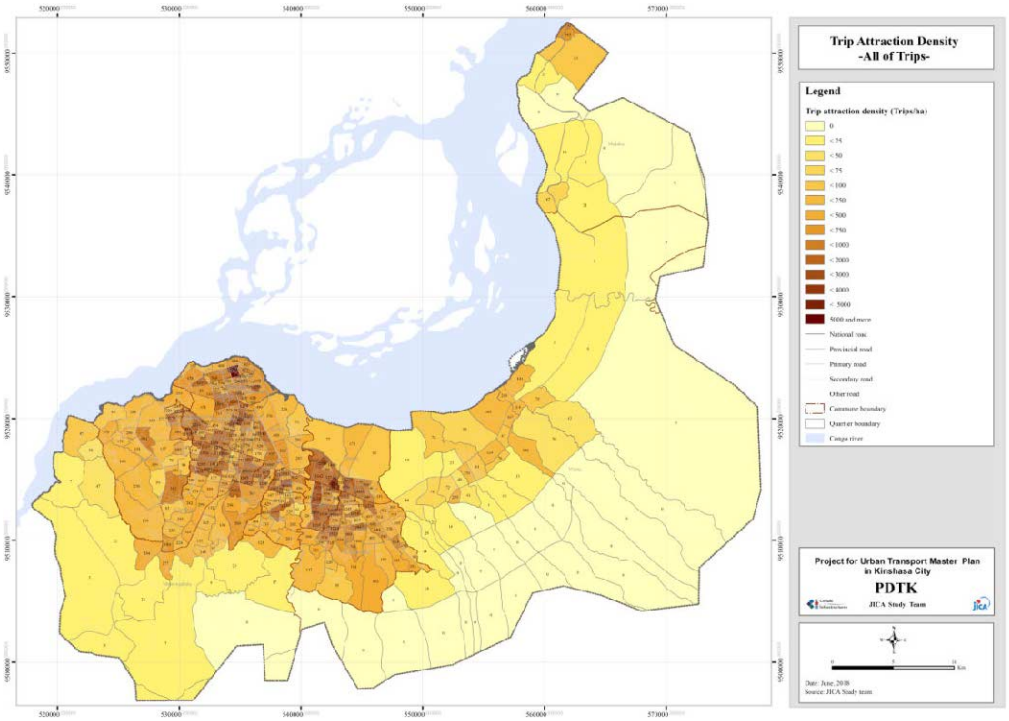
Figure 2.2.14 and Figure 2.2.15 show trip production and attraction density by Traffic Analysis Zone (TAZ) in the Study Area. The definition of the TAZ is explained in Section 2.3.

The maps visually show that the most significant concentration of trips is on the east side of Gombe Commune that includes the biggest local market, Grand Marché, and is regarded as the socio-economic centre of the Study Area.

The broadly expanded area crossing the N'djili and Masina Commnues can be defined as the sub-centre of the Study Area where large-scale schools such as Université Révérend Kim and the second biggest local market, Marché de la Liberté are located. The area between the Kasa-vubu and Kalamu Communes with a large transit terminal, Place de la Victoire, and a local market, Marché Gambela, also tend to attract more trips compared to the surrounding area.

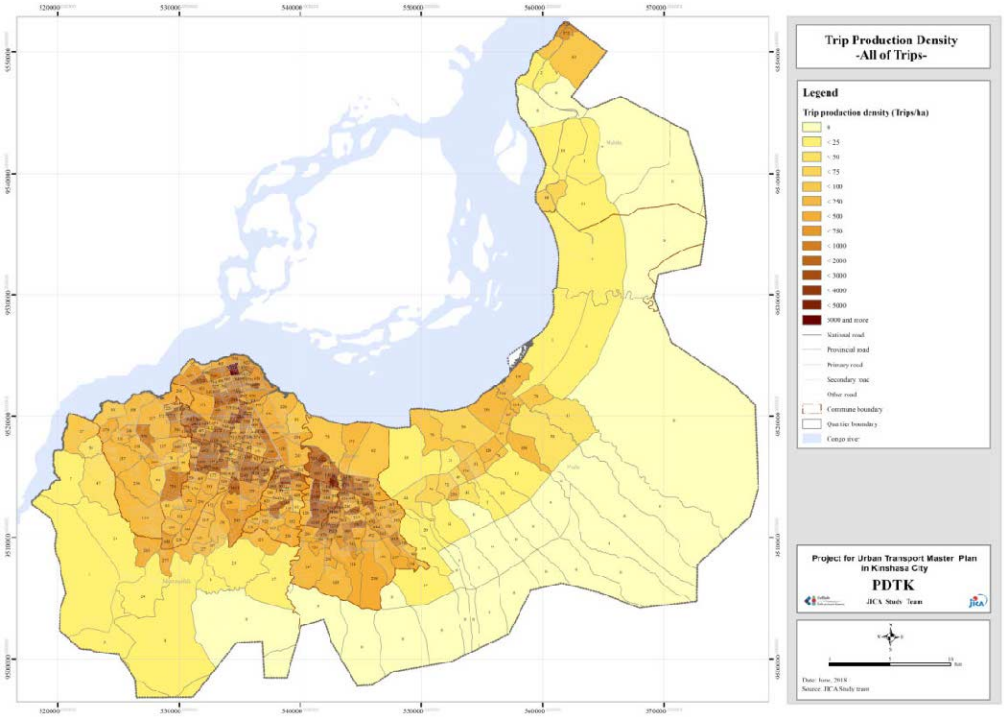
Looking south, the densely populated areas of Bumbu and Ngaba Communes are regarded separately.

Apart from the city centre and its surrounding areas, concentrations in the suburbs are observed around the major universities such as UniKin (University of Kinshasa / Université de Kinshasa) in Lemba Commune, and UPN (Université pédagogique nationale / National Pedagogical University) in Ngaliema Commune. In addition, a certain amount of trip attractions are observed in Maluku Commune.



Source: The Study Team

Figure 2.2.14 Trip Attraction Density by TAZ



Source: The Study Team

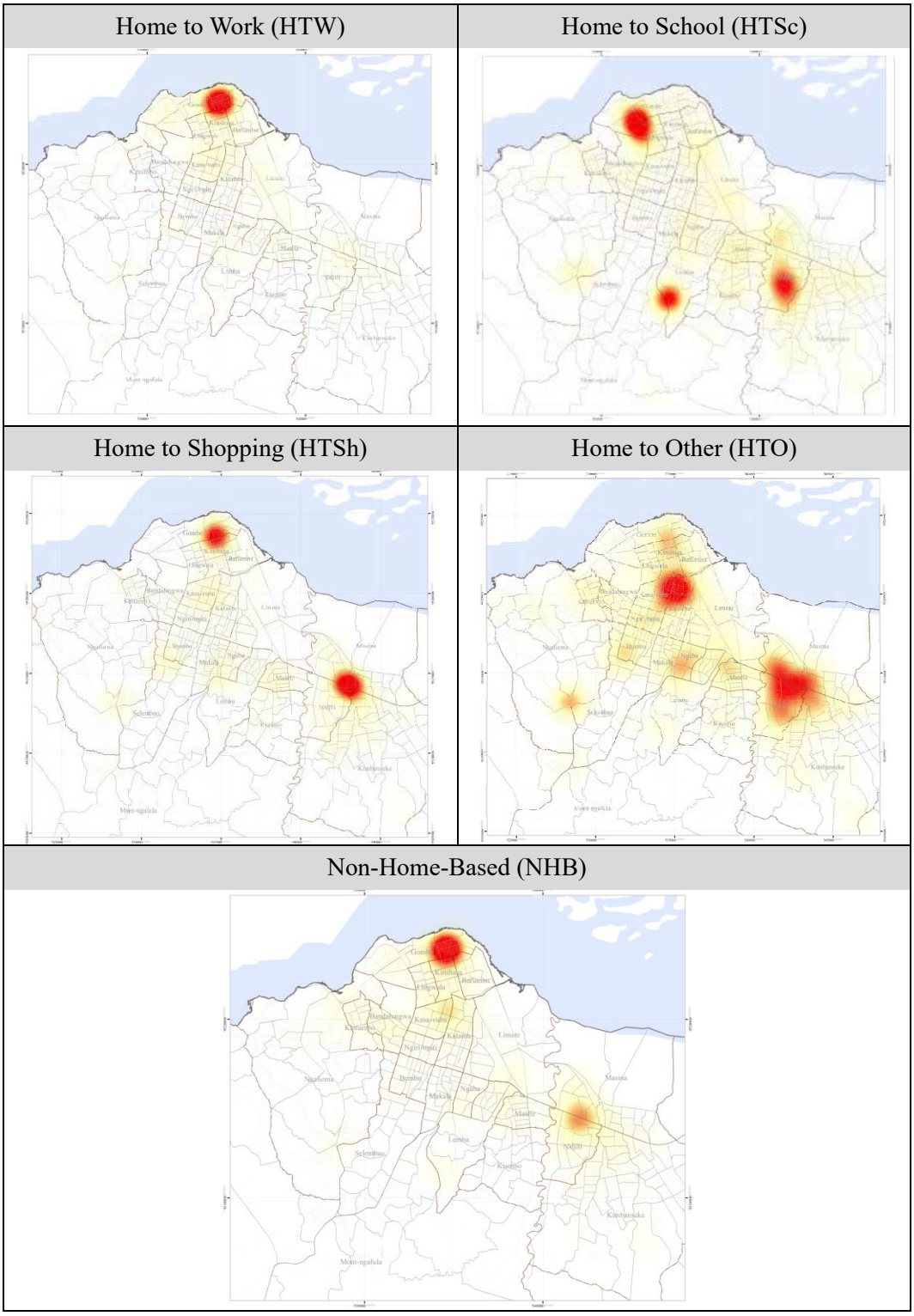
Figure 2.2.15 Trip Production Density by TAZ

h) Trip Attraction by Trip Purpose

Figure 2.2.16 demonstrates a distribution of trip attraction by trip purpose: Home to Work (HTW), Home to School (HTSc), Home to Shopping (HTSh), Home to Other (HTO), and Non Home-Based (NHB) purposes. The characteristics of trip attraction for each purpose can be regarded as follows.

- HTW: The sharp concentration of trips observed in the east side of Gombe Commune.
- HTSc: Trips concentrated around major universities in the Gombe, Lemba, Ngaliema and N'djili communes.
- HTSh: Trips concentrated sharply by the large-scale local markets, Grand Marché and Marché de la Liberté.
- HTO: Trips concentrated at the surrounding areas of the large-scale markets and transit centres such as Grand Marché, Marché de la Liberté, UPN, Place de la Victoire and Marché Gambela.
- NHB: Trips concentrated particularly on the east side of Gombe Commune, which are similar to the home-based work trips. In addition, the concentration around the major markets of Marché de la Liberté and Marché Gambela is observed.

These results indicate the highly biased dependence of the residents on the above-mentioned markets in terms of their socio-economic activities. In conclusion, travel behaviours are oriented around the local markets in the Study Area.



Source: The Study Team

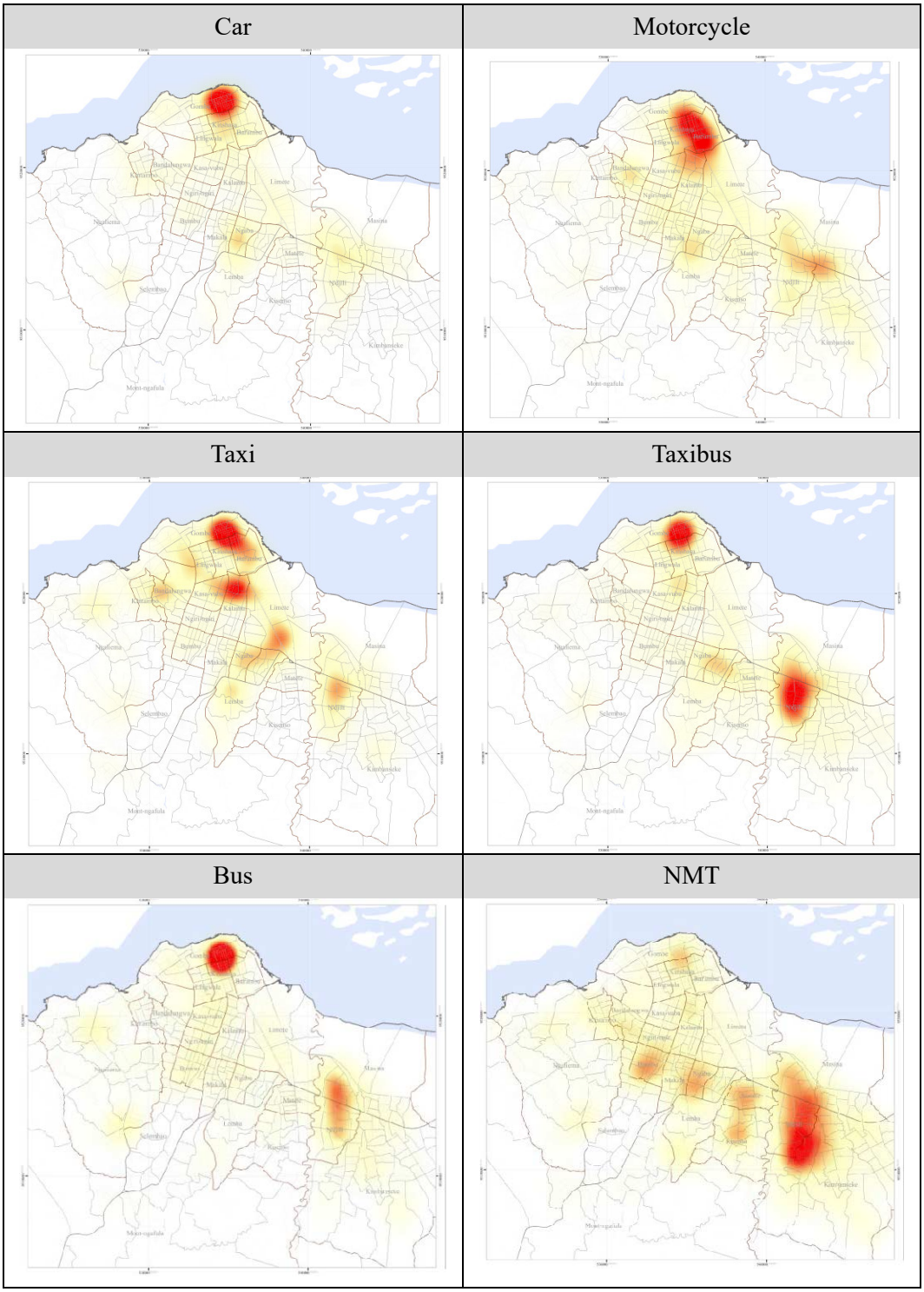
Figure 2.2.16 Distribution of Trip Attraction by Trip Purpose

i) Trip Attraction by Transport Mode

Figure 2.2.17 describes a distribution of trip attraction by transport mode. The characteristics of trip attraction for each trip purpose can be regarded as follows.

- Car: Trips by car sharply tend to concentrate on Gombe Commune.
- Motorcycle: Trips by motorcycle broadly tend to be attracted in the area crossing the Gombe, Kinshasa, Barumbu and Kalamu communes. Weak attractions in the Bandalungwa, Ngaba, Masina and N'djili communes are observed.
- Taxi: Trips by taxi tend to be distributed on the major taxi terminals such as Bokasa and Zando next to Grand Marche and Place de la Victoire, Beau Marche in Barumbu Commune, Super Lemba in Lemba Commune, and the N'djili area.
- Taxibus: Trips by taxibus tend to be characterized by their high concentration around the Gombe and N'djili communes.
- Bus: Trips by bus is similar to that of trips by taxibus. However, the attraction by bus tends to be more concentrated in Gombe Commune.
- NMT: Trips by NMT are attracted mainly in densely populated areas such as N'djili, a northwest of Kimbanseke, Matete, Kisenso, Ngaba and Bumbu communes.

These results demonstrate the diversity of trip destinations by transport mode, while the tendency of trip attraction in Gombe, Masina and N'djiri communes are almost similar to each mode.



Source: The Study Team

Figure 2.2.17 Distribution of Trip Attraction by Transport Mode

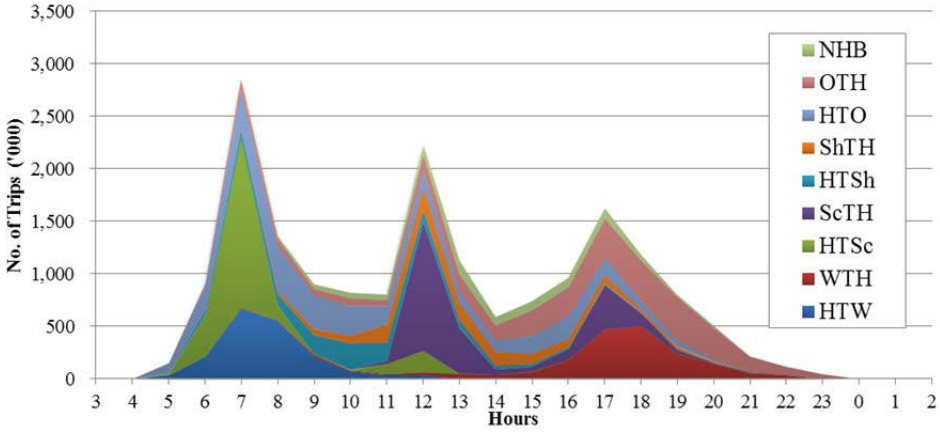
j) Hourly Fluctuation of Trip Attraction

Figure 2.2.18 and Figure 2.2.19 show the hourly fluctuation of attracted trips at their arrival time by trip purpose and transport mode, respectively. The graphs show that there are three peaks of trips within a day: the first peak at 7 AM, the second one at noon and third one at 5 PM.

The first peak is in the morning, which is mainly addressed by the contribution of trips from home to work and school. This peak is characterized by its sharpness and significant contribution of trips by NMT, compared to other two peaks.

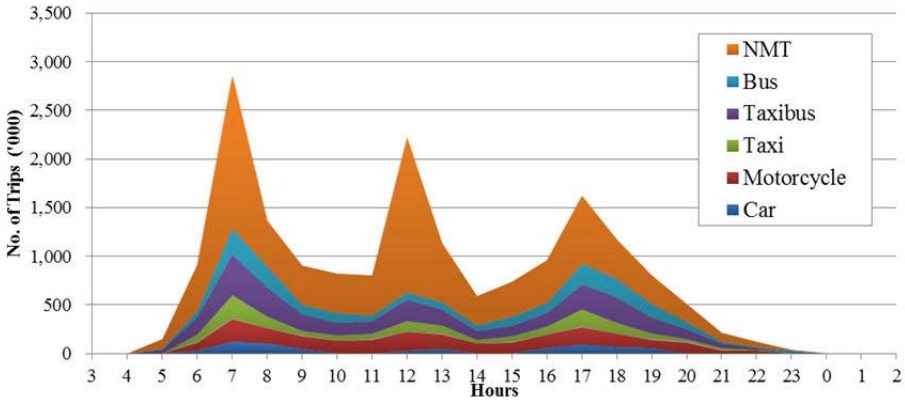
The second peak is at noon, which is dominantly caused by the occurrence of trips from school to home. In addition, there is the second peak of trips from home to school at the same time, while it is smaller than that in the morning.

The third peak is in the evening, which is integrally occurred by the concentration of trips to home. Interestingly, the share of trips by NMT tends to be lower than other peaks, because the home-based school trips whose main mode is NMT are not dominant.



Source: The Study Team

Figure 2.2.18 Hourly Fluctuation of All Trip Attraction by Trip Purpose



Source: The Study Team

Figure 2.2.19 Hourly Fluctuation of All Trip Attraction by Transport Mode

2.2.2 Screen Line Survey (SLS)

(1) Survey Method

The SLS consists of 2 surveys: 1) Classified Vehicle & Pedestrian Count Survey (VPC) and 2) Occupancy Survey (OCS). The vehicle classification and survey types are shown in Table 2.2.7

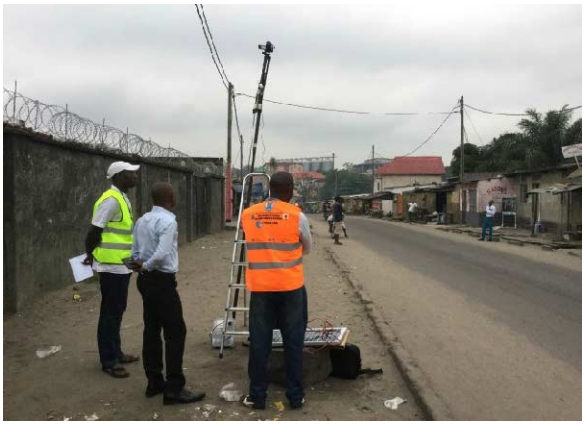
Table 2.2.7 Vehicle Classification and Survey Type

Vehicle Type			Survey Type
Motorized Transport	Type 1	Motorbike	VPC & OCS
	Type 2	Car, Jeep	
	Type 3	Passenger Van	
	Type 4	Pick-up (Single/ Double Cab)	
	Type 5	Light Truck (2 axle)l	
	Type 6	Heavy Truck (3 axles and more)	
	Type 7	Articulated Set (More than 3 axles)	
	Type 8	Minibus (26 seats and below)	
	Type 9	Large Bus	
	Type 10	Others	
Non-motorized Transport	Type 11	Cycle	VPC
	Type 12	Pedestrian	
	Type 13	Others	

Source: The Study Team

The VPC was conducted using digital video recorders. The vehicles are counted by viewing the digital video record by vehicle type and direction, at intervals of fifteen minutes.

The OCS was conducted by vehicle type and direction at intervals of 15 minutes. The number of passengers occupying private vehicles (type 1, 2, 4, 5, 6, 7, and 10) were counted. On the other hand, occupancy for public transport (type 3, 8, and 9) was estimated based on occupancy rate and vehicle size, due to the difficulty of accurately counting such passengers from the roadside. The sampling vehicles were selected randomly to exceed a sampling rate of 20%.




Source: The Study Team

Figure 2.2.20 Photo of Screen Line Survey

(2) Survey Location and Duration

The survey was conducted at forty six (46) locations for the VPC and eleven locations for the OCS, as shown in Table 2.2.8, Figure 2.2.21 and Figure 2.2.22. These locations were selected with consideration of assumed screen lines, location of past traffic count survey for analysing traffic growth, and calibration of transport demand projection.

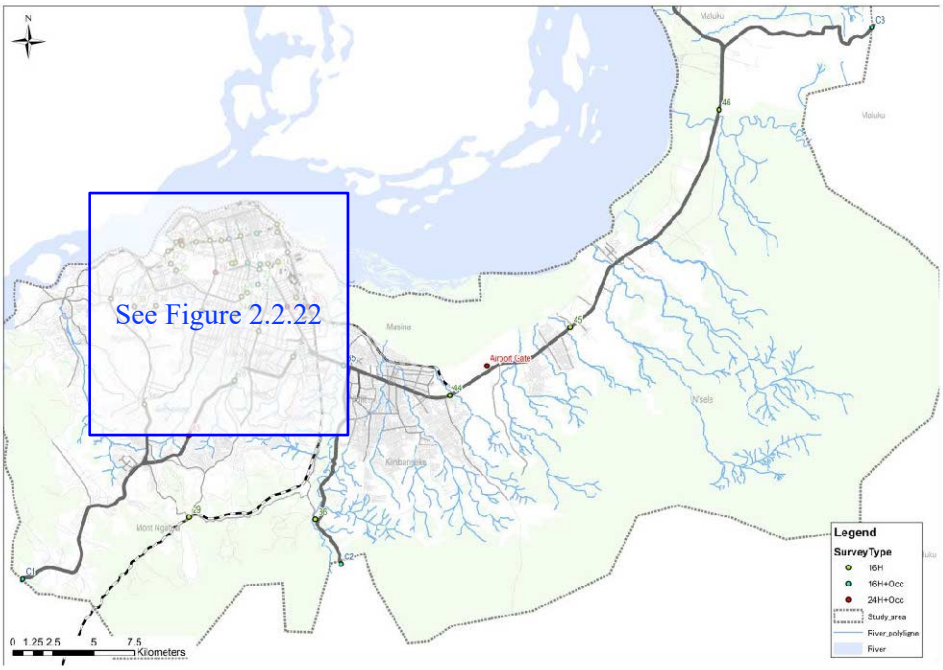
The survey duration was determined considering the quality, efficient survey execution, security for surveyors. Consequently, the VPC was conducted for three days with twenty four hour duration at five locations, to understand daily fluctuation and day-night rate in the Study Area. The remaining forty-one locations were conducted for one day with sixteen hour duration (6AM to 10 PM) due to security concern and consideration of impact to daily traffic volume. The sixteen hour traffic volume was expanded utilizing the day-night rate. The OCS was conducted for sixteen hours (6AM to 10 PM) due to visibility of inside the vehicles.

Table 2.2.8 Survey Location and Duration

Seq	Survey Station	Road Class	No of Lanes	VPC		OCC	Survey Date	Note
				24 H * 3 D	16 H	16 H		
1	Congo-Japon Boulevard (BATA)	PR	4		✓		20-Jun	
2	JOSEPH KABASELE	SR	2		✓		20-Jun	
3	KASAÏ Avenue	SR	2		✓	✓	15-Jun	
4	Kasa-vubu (Kilosa & Mbomu)	PR	4		✓		14-Jun	
5	Huillerie (Marché Rail)	PR	4		✓	✓	14-Jun	
6	MUSHIE Avenue	SR	2		✓		13-Jun	
7	LIBERATION (mson Schegen)	PR	6		✓		20-Jun	
8	Haut commendement	SR	2		✓		15-Jun	
9	MALEMBA NKULU Avenue	SR	2		✓		15-Jun	
10	30Juin Bld (Ministère de Finance)	PR	8	✓		✓	14-15,18,20-21 -	*1
11	Justice Avenue	SR	2		✓		15-Jun	
12	Congo-Japon Boulevard (Ndolo)	PR	4		✓		19-Sep	
13	Huilerie (Stade de Martyr)	PR	4		✓		20-Jun	
14	Forgerons Avenue	SR	2		✓		19-Sep	
15	Lumumba Bld (Usine Complast)	PR	4		✓		22-Jun	
16	Luambo Makiadi	SR	2		✓	✓	13-Jun	
17	Kasa-vubu	PR	4		✓	✓	22-Jun	
18	Contour Palais du Peuple	SR	4		✓		19-Sep	
19	Liberation (UPC)	PR	6	✓		✓	15,18,20-22 - Jun	*1
20	Kisangani Avenue /Hopital	SR	2		✓		13-Jun	
21	OUA 1 (Hôtel Diplomate)	SR	2		✓		14-Jun	
22	Mondjiba	PR	6		✓		22-Jun	
23	Sendwe Bld	PR	6		✓		14-Jun	
24	Pierre Elengesa	SR	2		✓		20-Jun	
25	Victoire (Ecole de Navigation)	SR	2		✓	✓	14-Jun	
26	Bongolo (Université Kimbaguiste)	SR	2		✓		18-Sep	
27	Mompono	SR	2		✓		19-Sep	
28	By Pass	NR	2		✓		20-Sep	
29	Kimwenza Gare	SR	2		✓		27-Jun	
30	Congo-Japon Boulevard (entrée TP zala na mbangu)	PR	4	✓		✓	18,20-21 - Jun	
31	BOBOZO Avenue	-	2		✓		22-Jun	
32	Lumumba Bld	PR	8	✓		✓	21-22, 25 - Jun	
33	By pass (Camp Mobutu)	NR	4		✓		21-Jun	
34	L. Desire Kabila	NR	4		✓		27-Jun	
35	Lumumba Bld (Pont rivière N'djili)	NR	8		✓	✓	21-Jun	
36	Paix Avenue (N'djili Brasserie)	NR	2		✓		27-Jun	
37	L. Desire Kabila (Centre Sup. Militaire)	PR	2		✓		18-Oct	
38	Nguma Avenue	SR	2		✓		20-Sep	
39	Mbenseke Avenue	SR	2		✓		12-Sep	
40	Liberation	PR	2		✓		18-Oct	
41	Kasa-vubu (Force Publique)	PR	2		✓		18-Oct	
42	University Avenue	PR	2		✓		19-Sep	
43	By Pass (Masanga Mbila)	NR	2	✓		✓	20, 22, 25 - Jun	
44	Lumumba Bld (Ndjoko)	NR	8		✓		22-Jun	
45	Lumumba Bld (Bibwa)	NR	6		✓		27-Jun	
46	Lumumba Bld (Rivière N'sele)	NR	6		✓		18-Oct	

*1: Due to security issues during night time, survey was conducted on another day

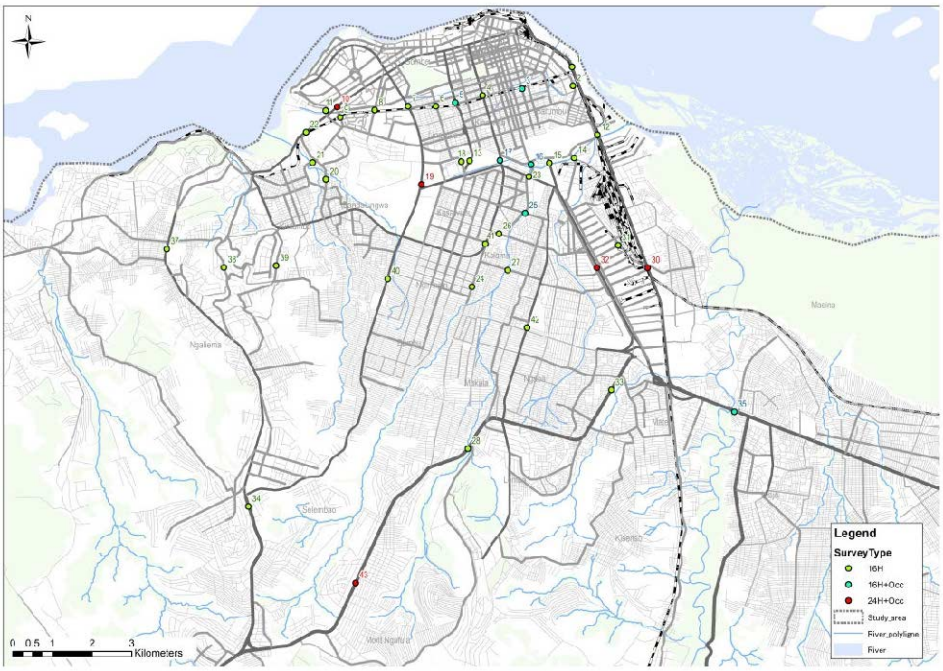
Source: The Study Team



Note: The C1, C2, C3 and airport gate are survey location of the CLS

Source: The Study Team

Figure 2.2.21 Survey Locations of the SLS (Whole Area)



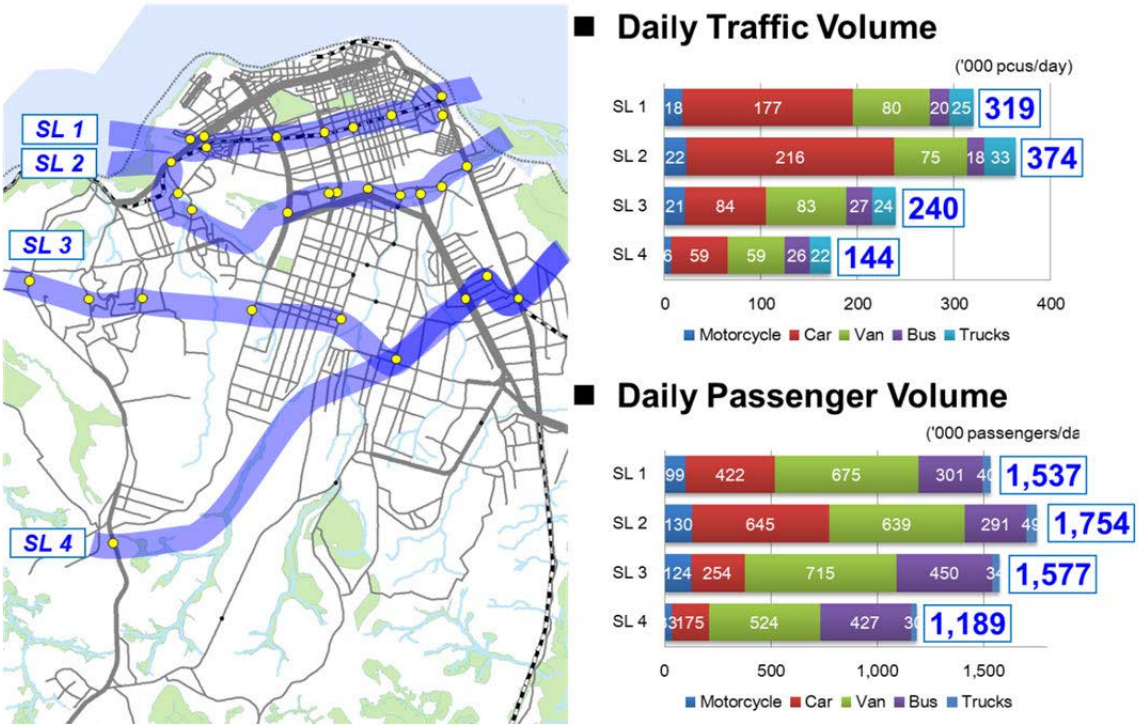
Source: The Study Team

Figure 2.2.22 Survey Locations of the SLS (Central Area)

(3) Basic Analysis and Major Findings

a) Daily Traffic Volume

The imaginary screen lines (SL) and the daily traffic and passenger volumes on the SLs are shown in Figure 2.2.23. It shows that vehicles and passengers are concentrating and increasing to/from the Gombe, Barumbu, Kinshasa, Lingwala communes. The heaviest traffic volumes and passengers were observed on SL2, as it reached 374,000 (pcu [1] s/day) and 1,754,000 (passengers/day), respectively.

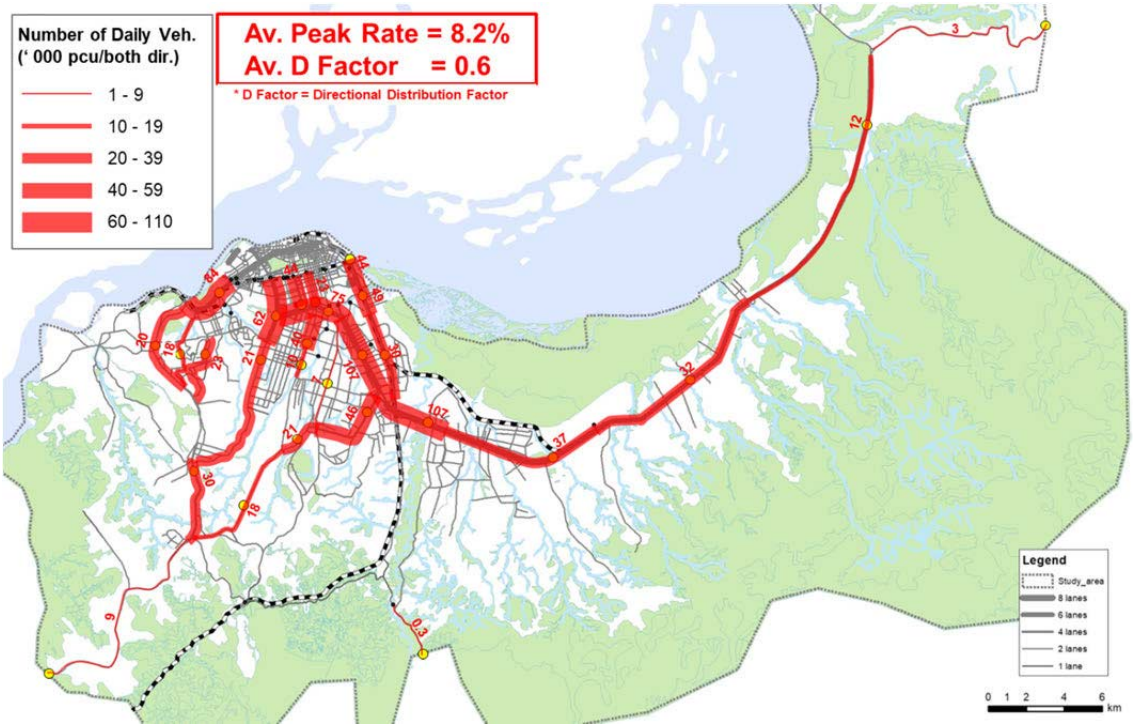


Source: SLS, The Study Team

Figure 2.2.23 Traffic and Passenger Volumes on Screen Lines

Figure 2.2.24 shows daily traffic volumes in the Study Area. This result indicates that traffic volumes are gradually increasing to/from the Gombe, Barumbu, Kinshasa, Lingwala communes; the average peak rate (peak rate) and directional distribution factor (D factor) were 8.2% and 0.6, respectively.

[1] PCU: Passenger car unit

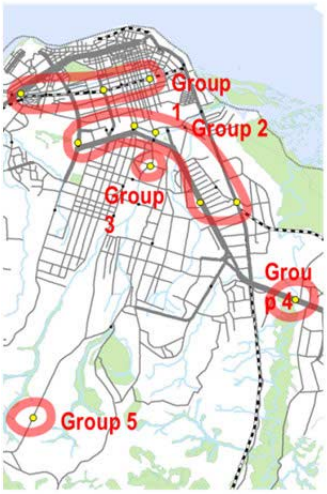


Source: SLS, The Study Team

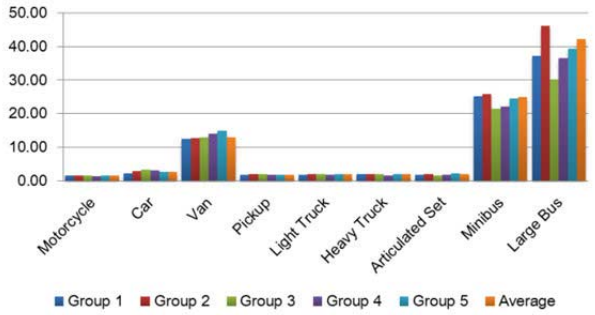
Figure 2.2.24 Traffic Volume (Whole Area)

b) Vehicle Occupancy

As shown in Figure 2.2.25, the vehicle occupancy of each vehicle type was estimated with consideration of the characteristics of each road and location. It indicates that average occupancies of motorcycle and cars are 1.70 and 2.82, respectively. The average occupancies of public transport were 13.13 for passenger van, 25.02 for mini bus and 42.29 for large bus.



Group	Motor cycle	Car	Van	Pickup	Light Truck	Heavy Truck	Articulated set	Mini bus	Large bus
1	1.68	2.37	12.59	1.94	1.93	2.04	1.93	25.15	37.24
2	1.73	3.00	12.83	2.02	2.07	2.09	2.15	25.93	46.17
3	1.70	3.33	13.00	2.18	2.11	2.09	1.67	21.56	30.25
4	1.57	3.22	14.21	1.98	1.82	1.77	1.91	22.10	36.64
5	1.62	2.83	14.93	2.01	2.18	2.13	2.44	24.65	39.40
Ave.	**1.70**	**2.82**	**13.13**	**1.99**	**2.02**	**2.05**	**2.17**	**25.02**	**42.29**

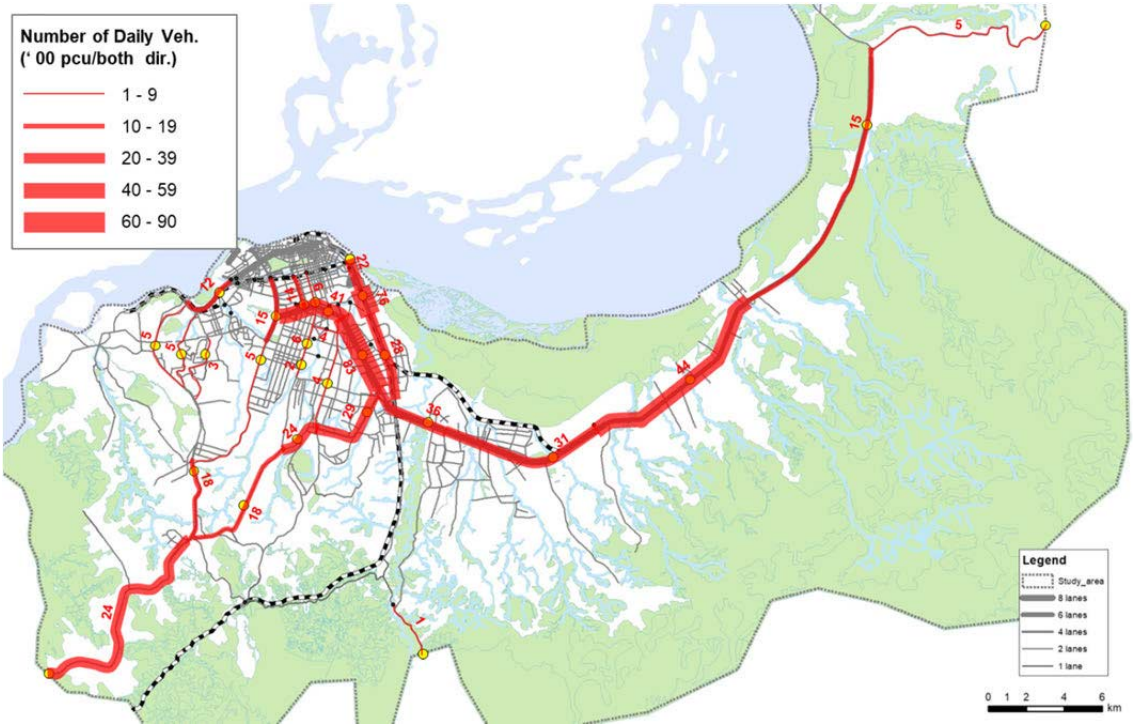


Source: SLS, The Study Team

Figure 2.2.25 Vehicle Occupancy

c) Freight Vehicle Volume

The traffic volumes of freight vehicles are shown in Figure 2.2.26. This result indicates that freight vehicles to/from the Matadi direction are passing Bypass, Boulevard Lumumba, and Boulevard Congo-Japon, and into the city centre.

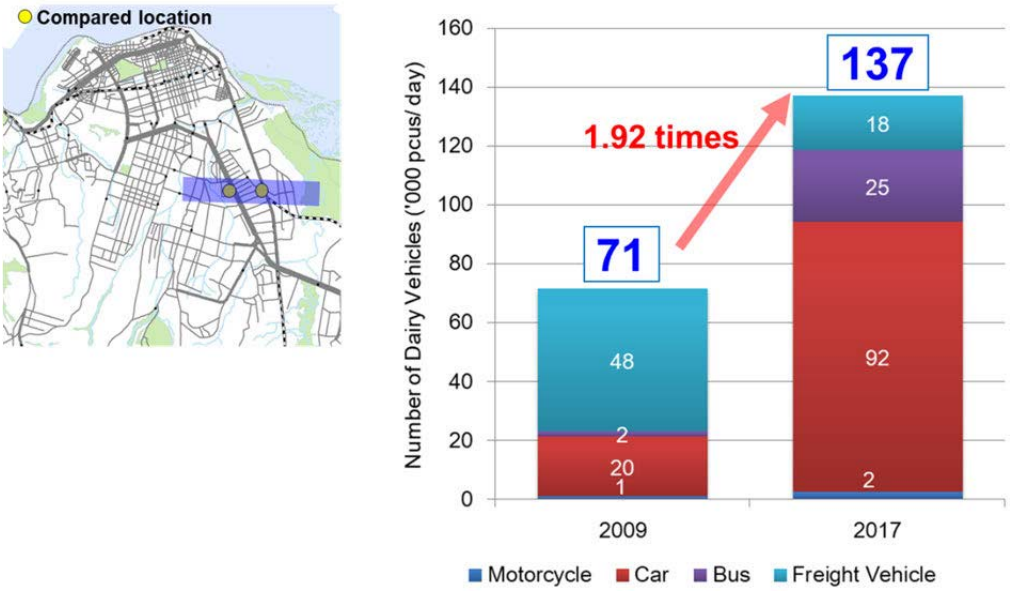


Source: SLS, The Study Team

Figure 2.2.26 Freight Vehicle Volume (Whole Area)

d) Traffic Growth

Figure 2.2.27 shows comparison of total traffic volume on Lumumba Boulevard and Congo-Japon Boulevard. The result indicates that traffic volume has significantly increased in the past 8 years, increasing by 1.9 times in this period.



Source: SLS, The Study Team

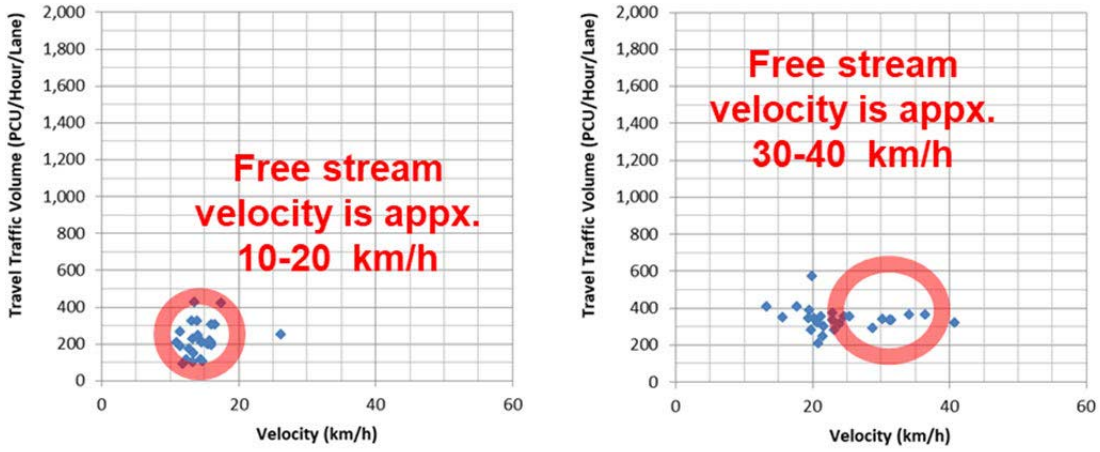
Figure 2.2.27 Traffic Volume Comparison

e) Road Capacity

Figure 2.2.28 and Figure 2.2.29 shows scatter graphs of traffic volume and velocity based on the results of the SLS and TSS (Travel Speed Survey). The survey method and detailed results of the TSS are summarized in the following Section.

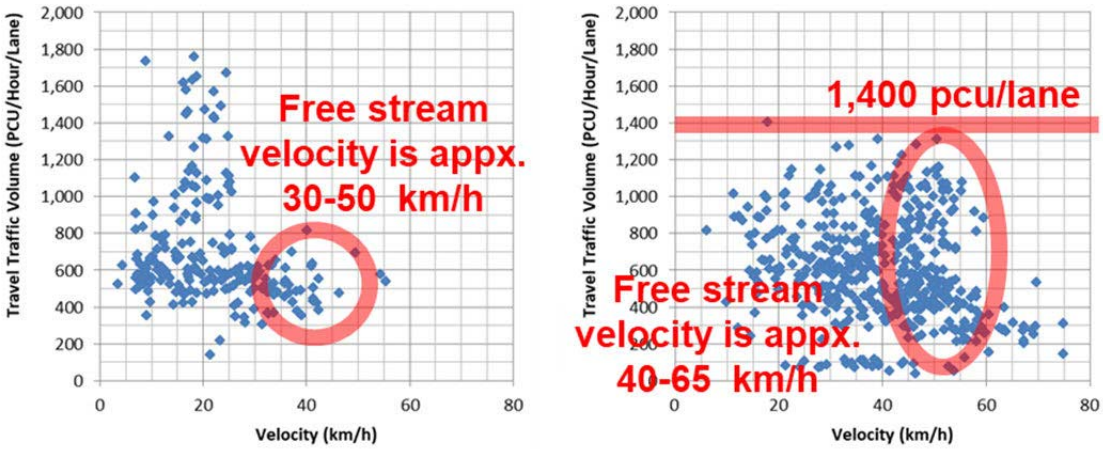
This result indicates that the free stream velocity of unpaved road is approximately 10-20 km/h, due to the poor road surface condition. On the other hand, the free stream velocities of one-way roads in the urban area, 2 lanes road, and multi-lane roads (4, 6, and 8 lanes) are 30-40 km/h, 30-50km/h, and 40-65 km/h, respectively. The free stream velocity of one-way roads in the urban area is slightly lower than that of multi-lane roads.

The road capacity for multi-lane roads without specific disturbance of traffic flow is generally 1,800–2,000 pcu/lane/hour. However, current maximum traffic volume is 1,400 pcu/lane/hour. It shows that current traffic capacities can be improved if appropriate traffic management is implemented.



Source: SLS, The Study Team

Figure 2.2.28 QV Graph (Left: Unpaved Road, Right: One way Road)



Source: SLS, The Study Team

Figure 2.2.29 QV Graph (Left: 2 Lanes, Right: 4, 6, & 8 Lanes)

2.2.3 Cordon Line Survey (CLS)

(1) Survey Method

The CLS consists of five surveys: 1) Classified Vehicle and Pedestrian Count Survey (VPC), 2) Roadside OD Interview Survey (RODI), 3) Bus Passenger Loading Survey (BPLS), and 4) Bus Passenger OD Interview Survey (BODI), 5) OD interview survey at airport (AODI).

The VPC was conducted using digital video recorders. The vehicles were counted by viewing the digital video record by vehicle type and direction, at intervals of fifteen minutes.

The RODI was conducted at the same survey station as the VPC. The surveyors stopped vehicles with the cooperation of police officers, to minimize disturbance to traffic flow as well as to ensure

traffic safety. The interview vehicles were selected randomly to exceed the sampling rate of 20% by vehicle types, and surveyors recorded vehicle type, number of passengers, address of origin/destination, trip purpose, commodity type and loading ratio (for freight vehicles).

The BPLS was conducted at the same survey station as the VPC. The surveyor recorded passing time, route number, operator, bus size, and passenger loading level.

The BODI was conducted by on-board interviews at the sections between the survey stations near the boundary of the Study Area. The surveyors boarded the selected bus and conducted an interview with a bus passenger quickly, then exited at another survey station. The minimum sampling rate was 5% of all bus passengers crossing the Study Area boundary.

The AODI was conducted with departing air passengers in the waiting room. The sample passengers were selected randomly to exceed a sampling rate of 10% of all departing air passengers, and the surveyors recorded the nationality, address of origin and/or landmark, origin type, trip purpose, access mode of transport, cost, travel time to the airport, accompanying passengers and flight information.

(2) Survey Location and Duration

To understand trip volume and trip information crossing the boundary of the Study Area, survey locations were selected on three major roads crossing the boundary of the Study Area, and N'djili Airport. It is noted that the passenger and freight movement to/from the port was surveyed by the Logistics Survey (LS).

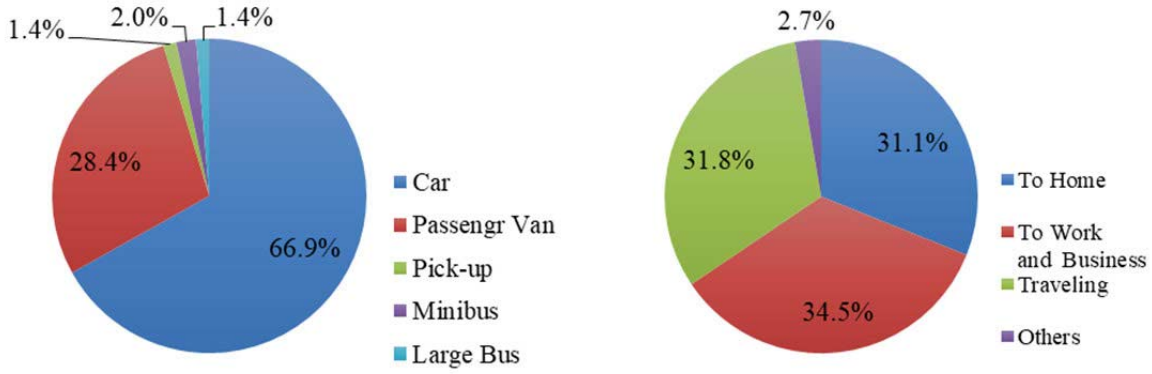
The location of the VPC, RODI, BPLS, and BODI is shown in Figure 2.2.21 and Figure 2.2.22, and was conducted for sixteen hours (6AM to 10 PM). Through the field inspection, it was observed that traffic volume during other times was very low, and its impact to the Study is very limited.

The AODI was conducted in the waiting room of N'djili Airport for 24 hours.

(3) Basic Analysis and Major Findings

a) Trip Characteristics of Air Passengers

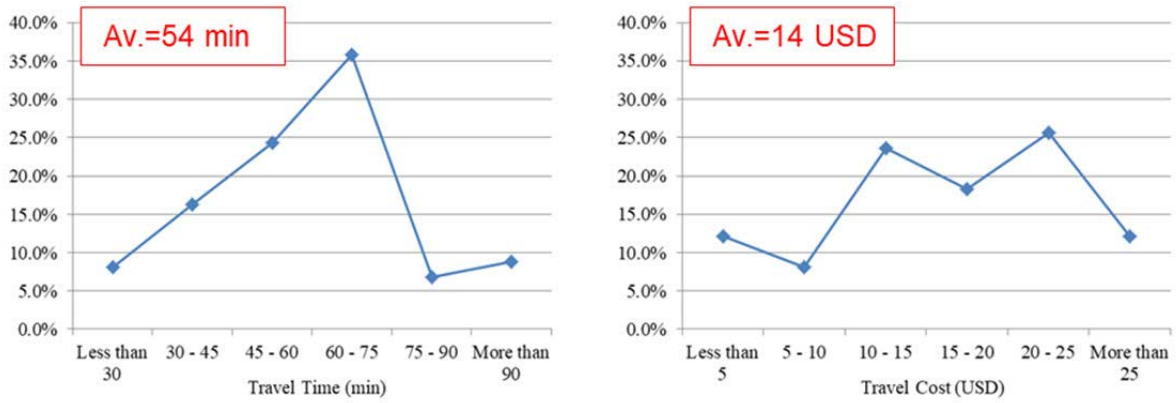
The daily numbers of departing and arriving air passengers were 1,390 and 1,316 passengers, respectively. Among the departing air passengers, car trips dominate at approximately 67%, followed by passenger van (incl. Esprit de Mort) at 28%.



Source: The Study Team

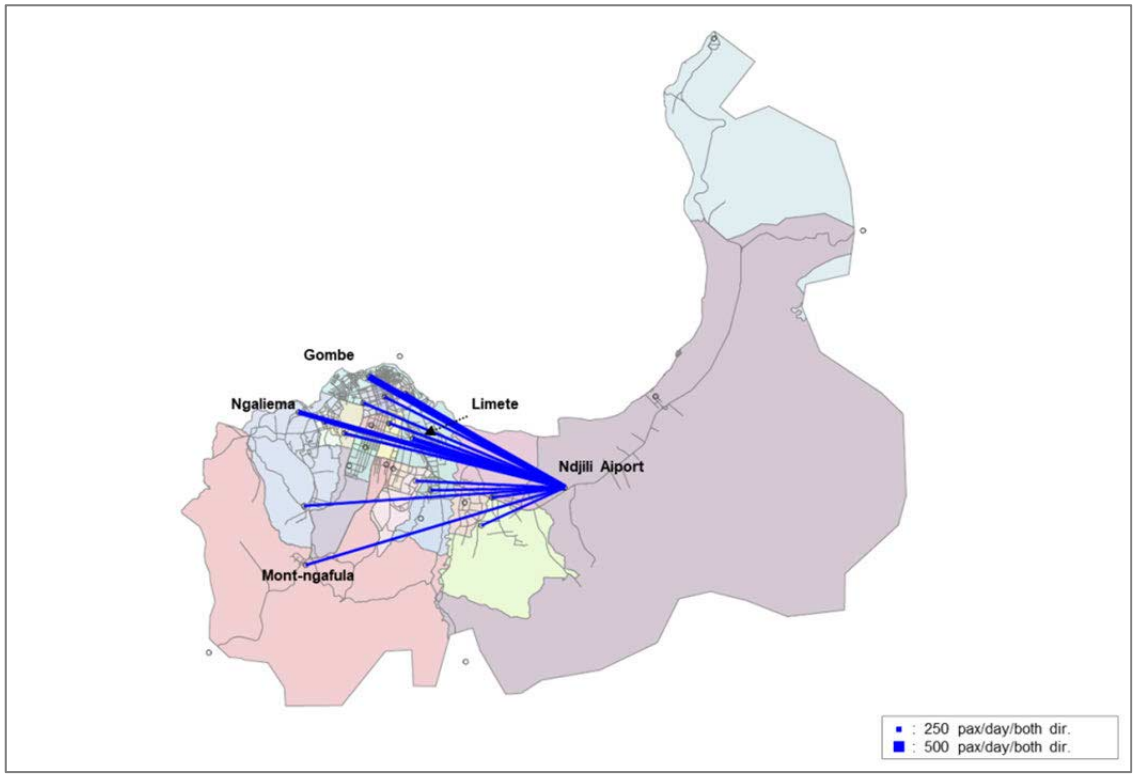
Figure 2.2.30 Access Mode and Trip Purpose to the N'djili Aiport (Left: Access Mode, Right: Trip Purpose)

As shown in Figure 2.2.31 and Figure 2.2.32, the major origin of departing air passengers were Gombe, followed by Ngaliema and Limete communes, and the average access time was 54 minutes. The average travel cost for air passengers was 14 USD.



Source: The Study Team

Figure 2.2.31 Average Access Time and Cost to the N'djili Aiport (Left:Time, Right:Cost)

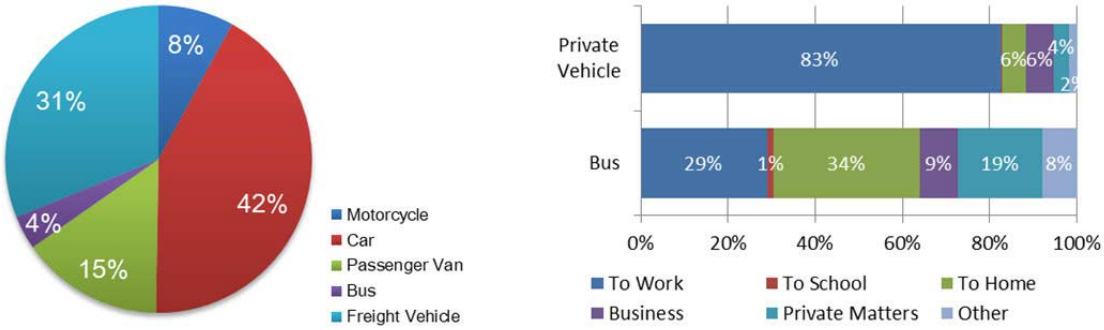


Source: The Study Team

Figure 2.2.32 Major Origin of Departing Air Passengers

b) Trip Characteristics at Matadi Road

Figure 2.2.33 shows the observed vehicle share and trip purpose on the Study Area boundary of Matadi Road. It indicates that the car is the highest share at 42%, followed by freight vehicles with 31%. Regarding trip purpose of private vehicles (motorcycle and car), the “to work” purpose is the largest share at 83%, followed by “to home” and “business”.

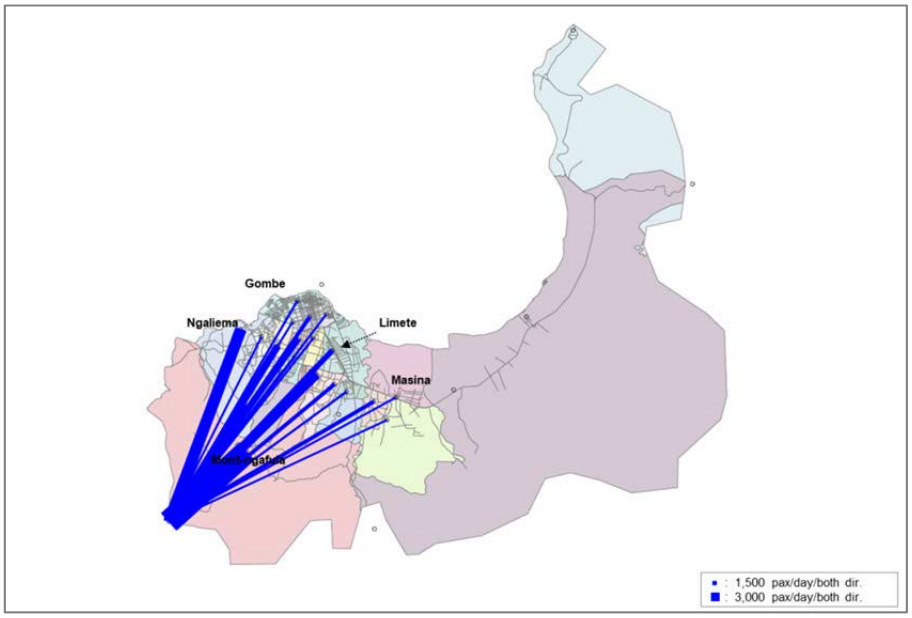


Source: The Study Team

Figure 2.2.33 Vehicle Share and Trip Purpose (Left: Vehicle Share, Right: Trip Purpose)

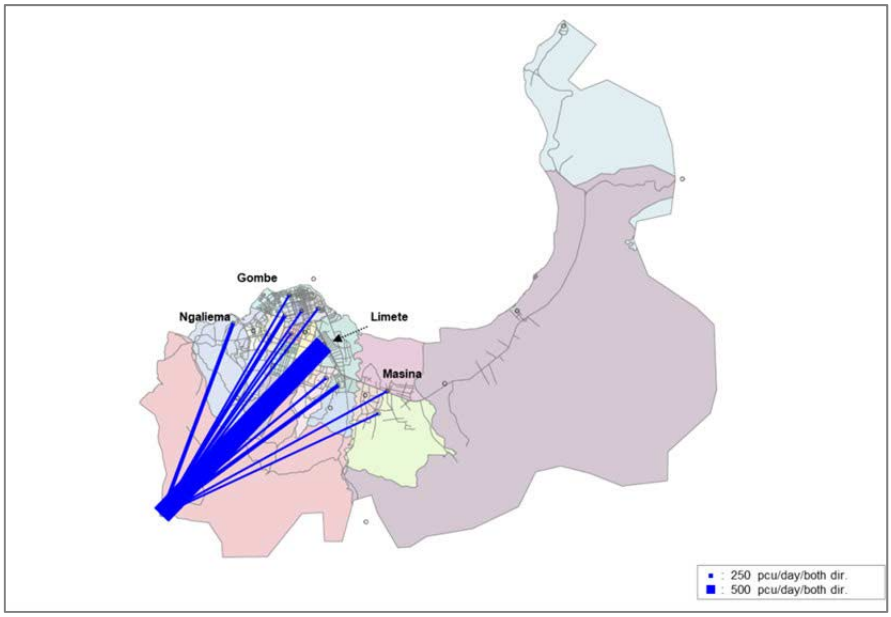
Figure 2.2.34 and Figure 2.2.35 show major origin and destination of passengers and freight

vehicles, respectively, on Matadi Road. It indicates that passenger trips to/from Mont-ngafula Communes are the largest share, followed by the Ngaliema and Limete communes. On the other hand, freight vehicles are concentrating on Limete Commune.



Source: The Study Team

Figure 2.2.34 Major Origin and Destination of Passengers on Matadi Road

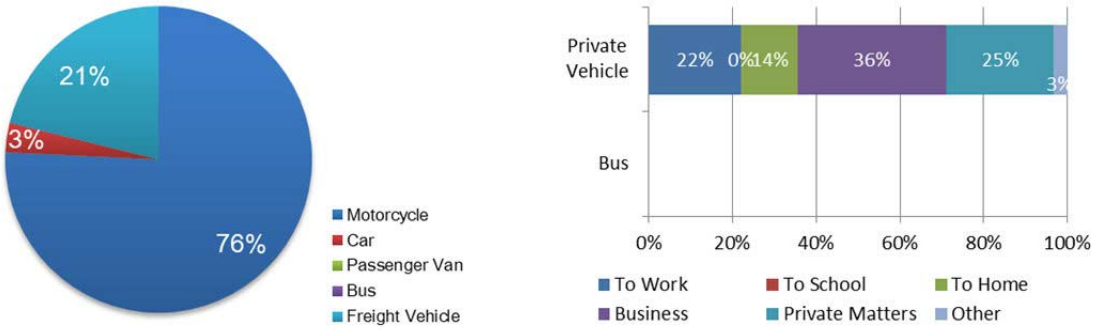


Source: The Study Team

Figure 2.2.35 Major Origin and Destination of Freight Vehicle on Matadi Road

c) Trip Characteristics at Secomaf Road

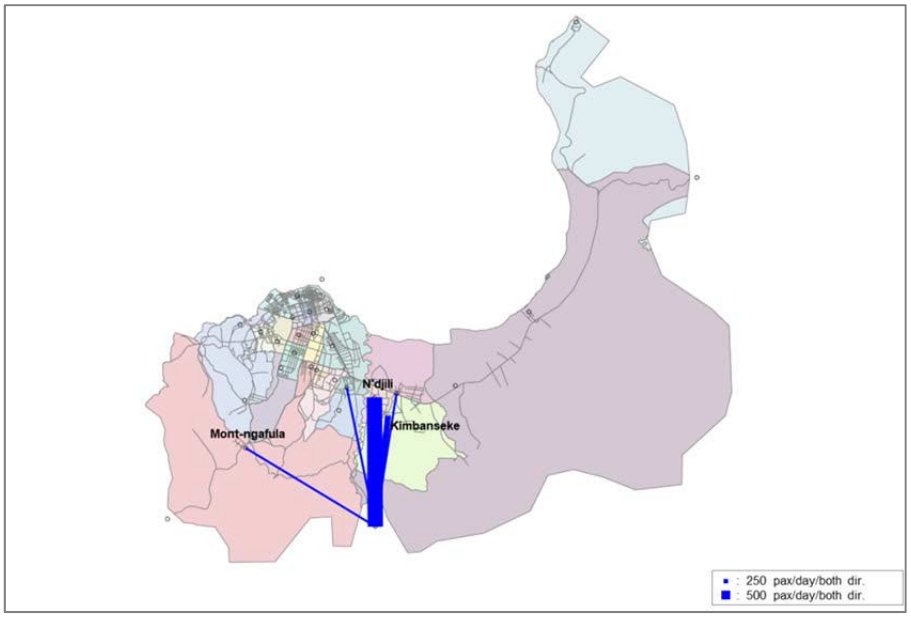
Figure 2.2.36 shows the observed vehicle share and trip purpose on the Study Area boundary of Secomaf Road. It indicates that the motorcycle mode is the highest share at 76%, followed by freight vehicles of 31%. Regarding the trip purpose of private vehicles, "business" purpose is the largest share of 83%, followed by "private matters" and "to work" purpose.



Source: The Study Team

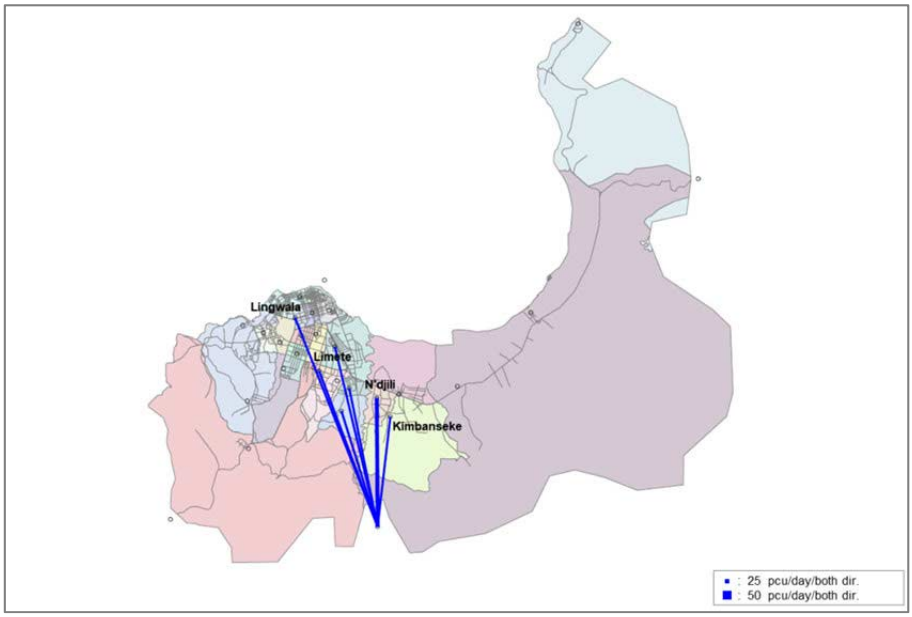
Figure 2.2.36 Vehicle Share and Trip Purpose (Left: Vehicle Share, Right: Trip Purpose)

Figure 2.2.37 and Figure 2.2.38 shows major origin and destination of passengers and freight vehicles, respectively, on Secomaf Road. It indicates that passenger trips to/from N'djili Commune are the large share, followed by Kimbanseke and Montngafula communes. On the other hand, freight vehicles are distributed among Limete, N'djili, Lingwala, and Kimbanseke communes.



Source: The Study Team

Figure 2.2.37 Major Origin and Destination of Passengers on Secomaf Road

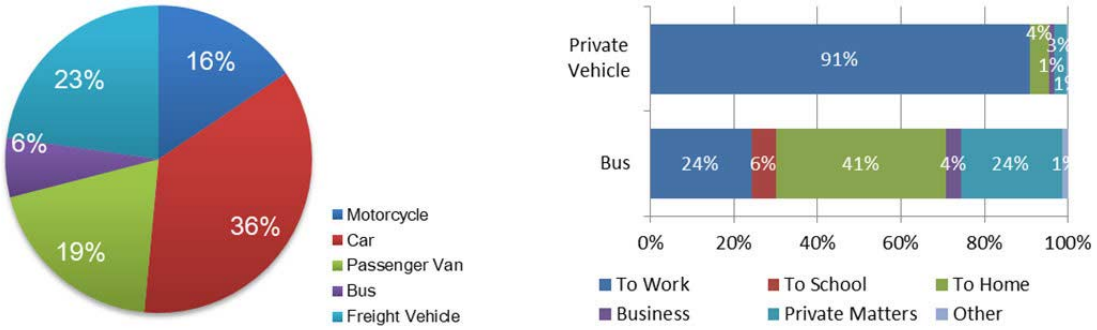


Source: The Study Team

Figure 2.2.38 Major Origin and Destination of Freight Vehicle on Secomaf Road

d) Trip Characteristics at Route Bandundu

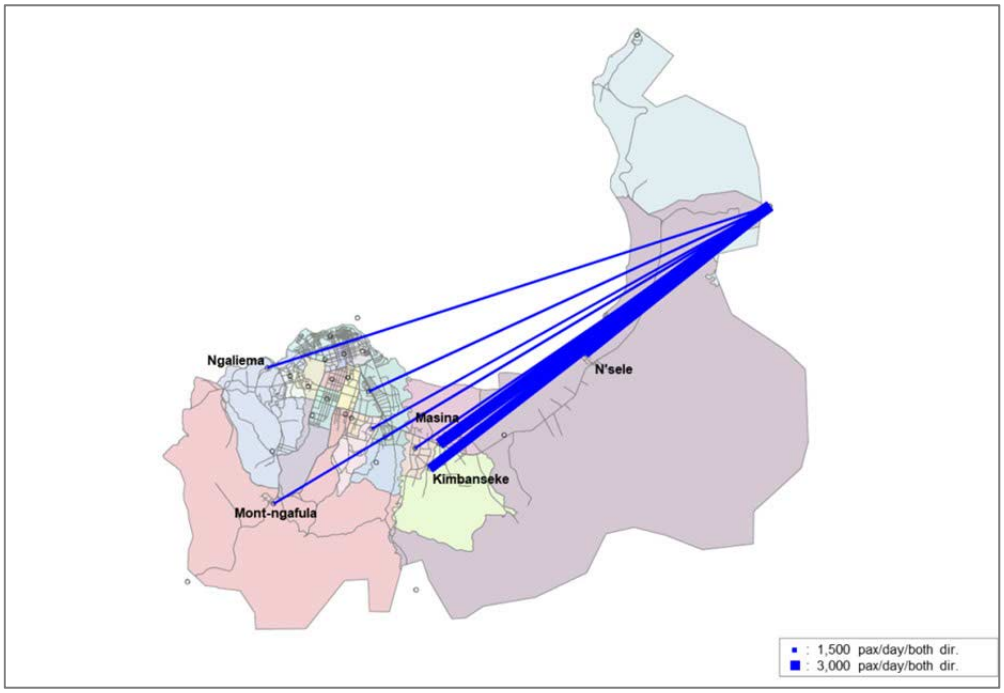
Figure 2.2.39 shows the observed vehicle share and trip purpose on the Study Area boundary of Route Bandundu. It indicates that the car is the highest share at 36%, followed by freight vehicles at 23% and passenger van at 19%. Regarding trip purpose of private vehicles, "business" purpose is largest share at 91%, followed by 'to home" and "private matters".



Source: The Study Team

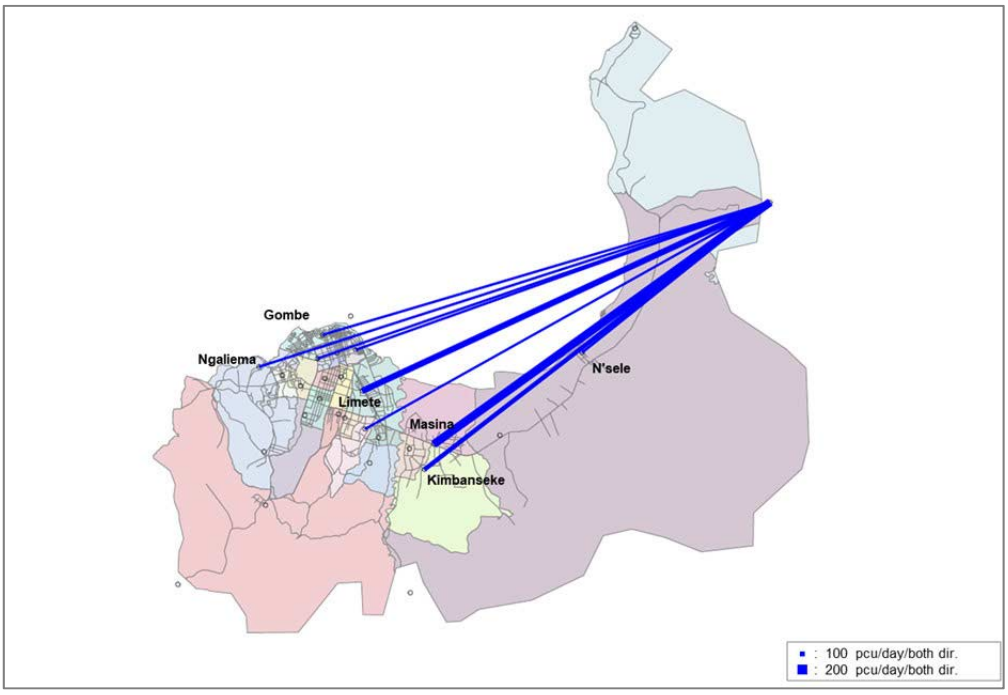
Figure 2.2.39 Vehicle Share and Trip Purpose (Left: Vehicle Share, Right: Trip Purpose)

Figure 2.2.40 and Figure 2.2.41 shows the major origin and destination of passengers and freight vehicles, respectively, on Route Bandundu. It indicates that passenger trips to/from Masina Commune are the large share, followed by the Kimbanseke and N'sele communes. On the other hand, freight vehicles are distributed among Masina, Kimbanseke, and Limete communes.



Source: The Study Team

Figure 2.2.40 Major Origin and Destination of Passengers on Route Bandundu



Source: The Study Team

Figure 2.2.41 Major Origin and Destination of Freight Vehicle on Route Bandundu

2.2.4 Directional Traffic Count Survey at Intersections (DTCS)

(1) Survey Method

The DTCS consists of four surveys: 1) Directional Traffic Count Survey at Intersection (DTCS), 2) Queue Length Survey (QLS), 3) Traffic Control Survey (TCS), and 4) Stopping Vehicle Survey (SVS). The vehicle classifications are the same as in the SLS.

The DTCS was conducted using digital video recorders. The vehicles were counted by vehicle type and direction, at intervals of fifteen minutes. In addition, the surveyors counted the number of pedestrians crossing the road for five minutes each hour.

The QLS recorded the queue length by five meter intervals every fifteen minutes.

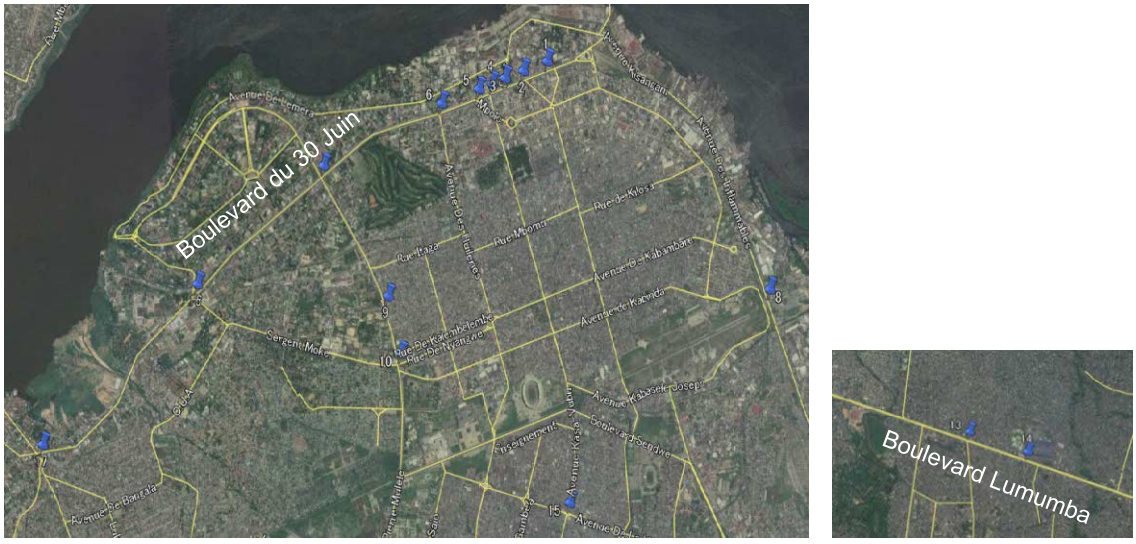
The TCS recorded the phasing time of the traffic signal (seconds for one cycle and each direction) where traffic signals are working.

In the SVS, the stopped or parked vehicles (such as buses, minibuses, ketches, moto taxies, and private cars) around these intersections, on streets, and roadsides that disturbed the traffic flow were counted, utilizing the video data at an interval of fifteen minutes during the survey hours.

(2) Survey Location Duration

Based on the field inspection, results of the Travel Speed Survey, and survey results of the PDNIT (National Integrated Transport Master Plan), 17 congested intersections in the Study Area were selected to analyse the cause of traffic congestion. The selected intersections are shown in Figure 2.2.42.

The survey duration was determined as 14 hours to measure congesting hour at these intersections.



Source: The Study Team, elaborated based on Google Earth Image© 2018 CNES / Airbus

Figure 2.2.42 Map of Survey Locations

(3) Basic Analysis and Major Findings

Table 2.2.9 shows the number of intersections by traffic volume level (14 hours PCU). Some non-signalized intersections and intersections with signals not in operation are heavily loaded with more than 75,000 PCU for 14 hours.

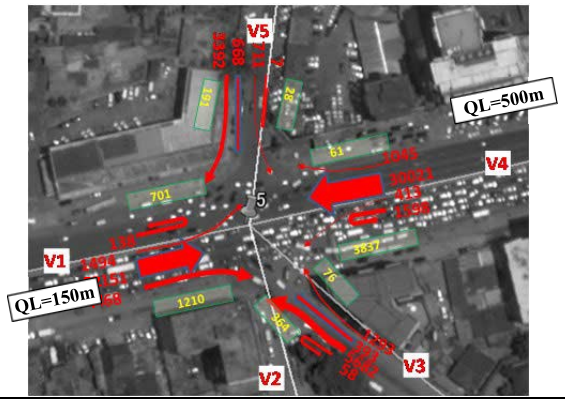
Table 2.2.9 Number of Intersections by Traffic Volume Level

14-hours PCU Volume	Non-signalized Intersection	Signalized Intersection	
		in operation	not in operation
>75,000	1	3	2
50,000-75,000	3	0	3
25,000-50,000	4	0	0
<25,000	0	1	0
Total	8	4	5

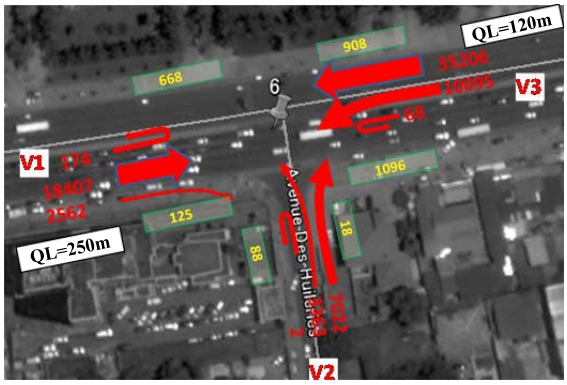
Source: the Study Team

As shown in Figure 2.2.44, it was observed that left-turning and U-turning vehicles disturbed traffic flow of straight-through vehicles, and traffic congestion was occurred at intersections. This is caused by inadequate traffic control; for example, these intersections either lack traffic signals or have traffic signals that are inactive due to breakdowns. In addition, many stopped vehicles, such as minibuses and taxies, were observed near the intersections. These vehicles reduced road capacity and disturbed smooth traffic flow at intersections, when then long queues occurred.

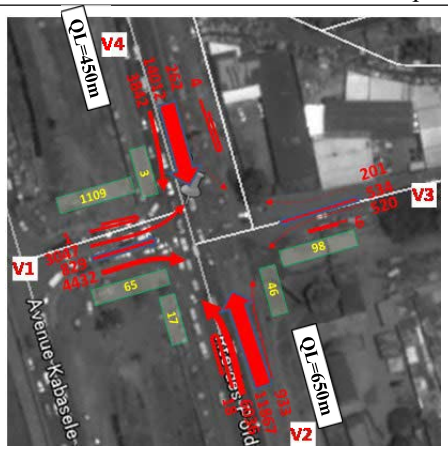
No.5 30 Juin Bld./ Kitona Ave/ Mpolo Ave/ Bandundu Ave



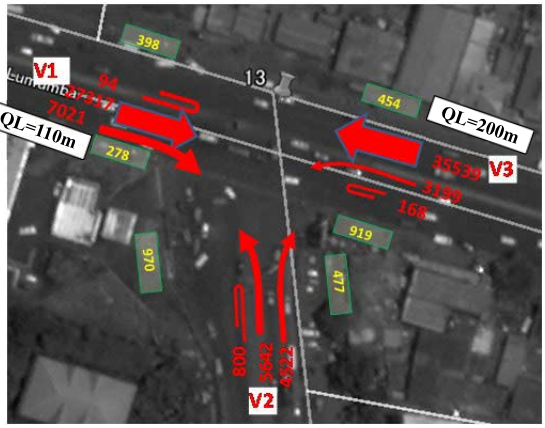
No.6 30 Juin Bld./ Huileries Ave



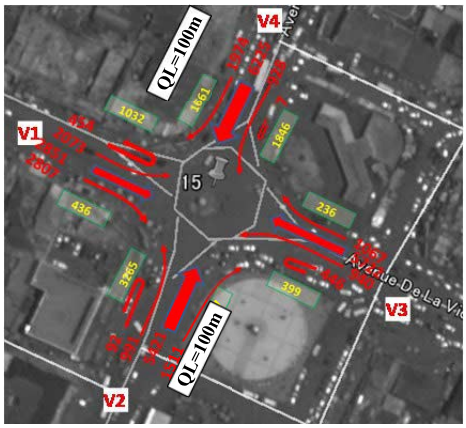
No.8. Poids lourds Ave./ Kabasele Joseph Ave.



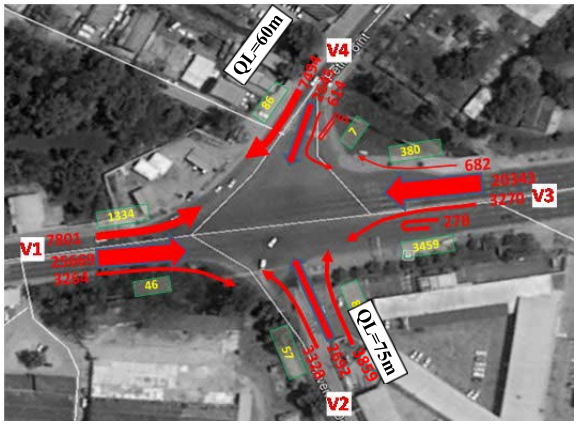
No.13 Lumumba Bld./ Kimbuta Bld.



No.15 Pole Victorire



No.16 Rond Point Socimat



Legend

Traffic Volume(based on PCU) for14hrs (6 :00am- 8 :00pm) QL : Maximum queue length (peak hours)

Number of Stopped vehicle for14hrs (6 :00am- 8 :00pm)

Source: The Study Team, elaborated based on Google Earth Image© 2018 CNES / Airbus

Figure 2.2.43 Example of Result of DTC Survey

Table 2.2.10 shows examples of intersection saturation rates. The intersection saturation rate was calculated as a premise in the appropriate condition, in which vehicles can drive in all lanes smoothly and there is proper traffic control by traffic signal. The surveyed intersections were practically congested, but the intersection saturation rate did not exceed 0.9 at most intersections. This means that traffic capacity at most intersections is sufficient for demand so far, but traffic capacity decreased by uncontrolled traffic or stopped vehicles around the intersections.

Table 2.2.10 Intersection Saturation Flow Rate

Intersection No.	Direction	Lane	Observed Traffic Volume	Adjusted Saturation Flow	Flow Raito	Intersection Saturation Flow
No. 5	V1	RT+TH	1,805	5,361	0.337	0.749
		LT	124	1,733	0.072	
	V4	RT+TH	2,965	5,453	0.544	
		LT	118	1,733	0.068	
	V3	RT+TH	99	1,618	0.134	
		LT+TH	351	1,743		
	V5	RT+TH	315	1,574	0.133	
		LT+TH	128	1,755		
No. 6	V1	RT+TH	916	5,271	0.230	0.780
		TH	697	1,733		
	V3	TH	1,887	5,472	0.625	
		LT+TH	2,619	1,733		
	V2	RT+TH	517	2,953	0.154	
		LT+TH	207	1,737		
No. 8	V2	RT+TH	368	1,813	0.342	0.710
		LT+TH	844	1,733		
	V4	RT+TH	1,097	1,740	0.544	
		LT+TH	793	1,733		
	V1	RT+TH	444	1,557	0.166	
		LT+TH	105	1,746		
	V3	RT+TH	19	1,745	0.019	
		LT+TH	47	1,761		
No. 13	V1	RT+TH	916	5,271	0.230	0.780
		TH	697	1,733		
	V3	TH	1,887	5,472	0.625	
		LT	2,619	1,733		
	V2	RT+TH	517	2,953	0.154	
		LT+TH	207	1,737		
No. 15	V1	RT+TH	721	3,172	0.202	0.369
		LT+TH	272	1,733		
	V3	RT+TH	219	3,507	0.084	
		LT+TH	221	1,733		
	V2	RT+TH	249	3,359	0.095	
		LT+TH	239	1,790		
	V4	RT+TH	508	3,441	0.167	
		LT+TH	369	1,815		
No. 16	V1	RT+TH	1,315	3,587	0.539	1.073
		LT	1,553	1,733		
	V3	RT+TH	918	5,447	0.317	
		LT	1,361	1,733		
	V2	RT+TH	344	1,549	0.473	
		LT+TH	389	0		
	V4	RT+TH	696	1,581	0.534	
		LT+TH	148	0		

Key: RT = Right turning lane; TH = Straight lane; LT = Left turning lane

Source: The Study Team

2.2.5 Parking Survey (PS)

(1) Survey Method

The PS consists of two surveys: 1) On-Street and Roadside Parking Survey and 2) Off-Street Parking Survey.

In the On-Street and Roadside Parking Survey, the number of parked cars (including stopped cars) on-street and roadside were counted through the observations of the surveyors, from the survey car carrying a GPS logger.

The vehicle classification for the On-Street and Roadside Parking Survey is as follows:

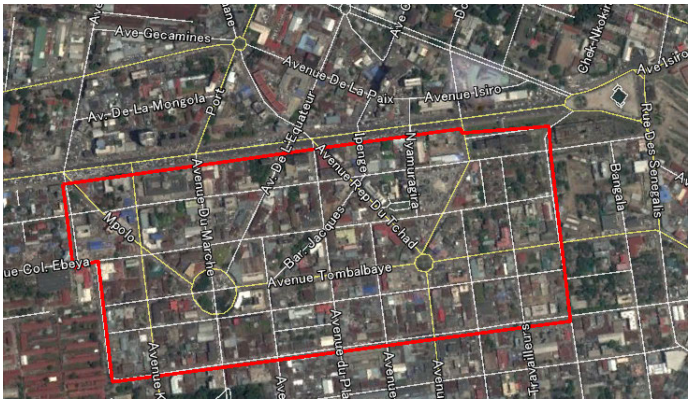
Type 1	Motorbike	Type 8	Minibus (26 seats and below)
Type 2	Car, Jeep	Type 9	Large Bus
Type 3	Passenger Van	Type 10	Others
Type 4	Pick-up (Single/ Double Cab)		
Type 5	Light Truck (2 axle)		
Type 6	Heavy Truck (3 axles and more)		
Type 7	Articulated Set (More than 3 axles)		

The status of parked and stopped vehicles is classified into the following three categories: 1) parked vehicle, 2) vehicle stopped for passengers (boarding/alighting) and 3) vehicle stopped for loading/unloading goods.

In the Off-Street Parking Survey, the number of parked vehicles in the survey area and assumed parking capacity in each parking lot was counted using satellite images of the survey area.

(2) Survey Area and Duration

The survey was conducted for fourteen hours (6 AM to 8 PM) inside of the red highlighted area as shown in Figure 2.2.44. The area was determined as an example in the Gombe Commune, to understand demand and supply for parking spaces and propose traffic management policies in the Study.



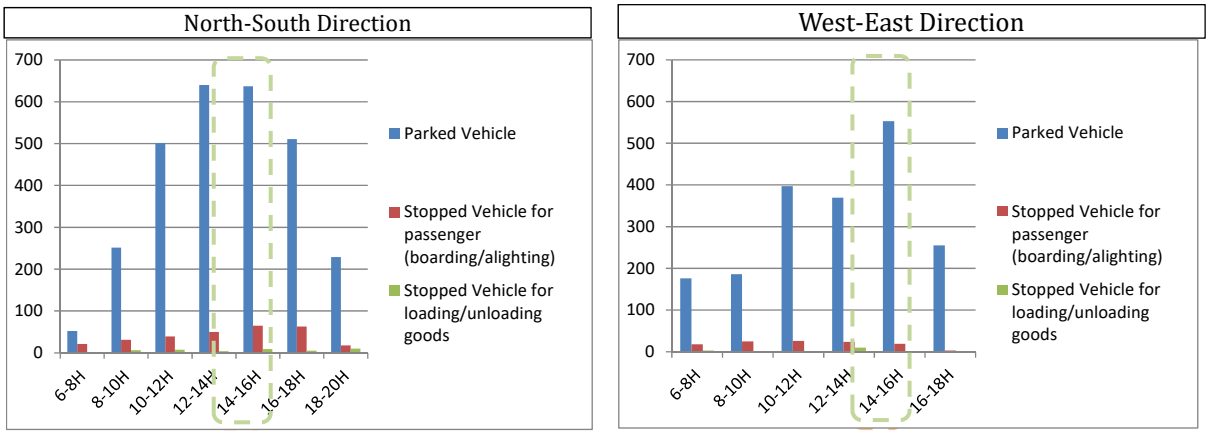
Source: The Study Team, elaborated based on Google Earth Image© 2018 CNES / Airbus

Figure 2.2.44 Map of Parking Survey Locations

(3) Basic Analysis and Major Finidngs

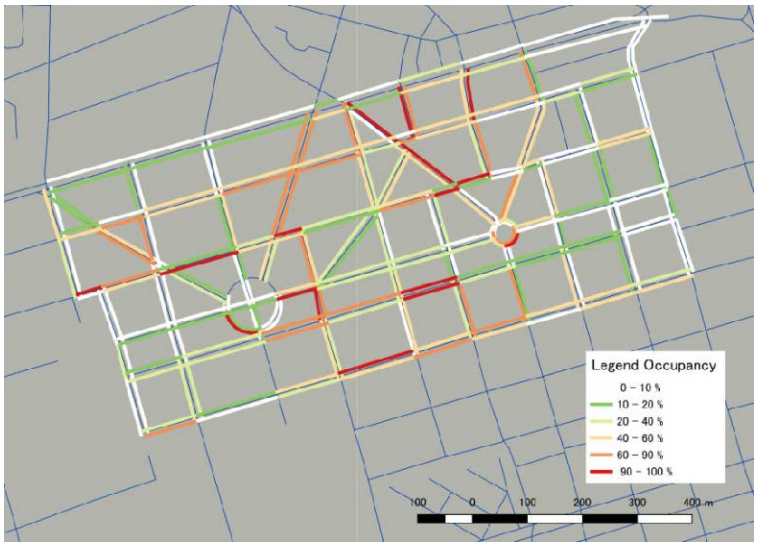
Figure 2.2.45 shows the number of stopped and parked vehicles counted by the On-Street Parking Survey. The period with the highest number of on-street parking was during 2 pm to 4 pm.

Figure 2.2.46 shows a diagram of the on-street parking occupancy of each street. In the sections where the occupancy rate was high, there are restaurants, hotels and numerous shops. Owners of these vehicles parked on the street can be assumed to be visiting this commercial area for the purpose of eating, shopping and/or working.



Source: The Study Team

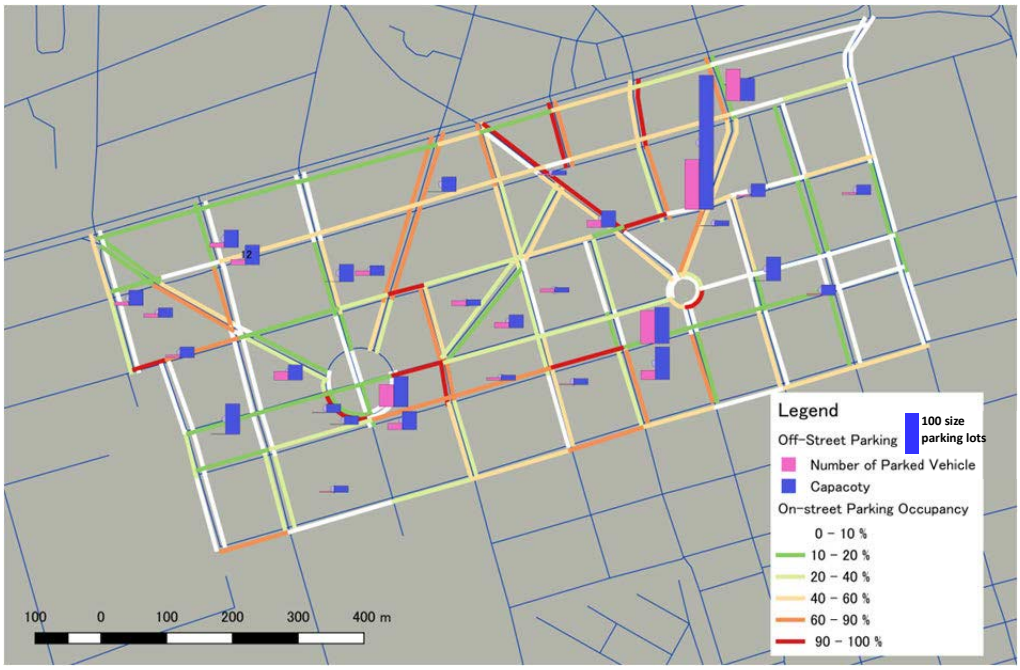
Figure 2.2.45 Number of On-Street Parking Vehicles Every 2-Hour Interval



Source: The Study Team

Figure 2.2.46 Diagram of On-Street Parking Occupancy (2pm-4pm)

On the other hand, Figure 2.2.47 shows the results of the Off-Street Survey. The result shows that there is still space in most of the off-street parking areas, indicating that these parking lots are underutilized.



Source: The Study Team

Figure 2.2.47 Survey Result of Off-Street Parking

Table 2.2.11 shows the supply and demand of parking spaces in the survey area. Some of the parking lots have empty spaces; however, the overall parking numerical demand exceeds the total capacity of off-street parking spaces. This means that it is necessary to optimize the existing parking lots by preparing new parking spaces, managing proper on-street parking, and providing information on empty parking spaces.

Table 2.2.11 Supply and Demand of Parking Space in the Survey Area

Block	On-street		Off-street				
	North+South	East+West	Demand	Capacity	Ratio	Parking Demand	Ratio
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
					(c)/(d)	(a)+(b)+(c)	(f)/(d)
A	122	114	57	264	22%	293	111%
B	121	111	127	320	40%	359	112%
C	214	100	211	428	49%	525	123%
D	115	96	117	297	39%	508	171%
Total	572	421	512	1309	39%	1505	115%

A	C
B	D

Source: The Study Team

2.2.6 Trip Generation Survey (TGS)

(1) Survey Method

The TGS consists of four surveys: Interview Survey with Business Establishment (ISBE), Classified Vehicle and Pedestrian Count Survey (VPC), Person Count Survey (PCS), and Interview Survey with Facility Users (ISFU).

In the ISBE, the surveyors visited all of the tenants located in each target building and interviewed company profiles, such as industry type, number of visitors on average, and number of employees.

In the VPC, the surveyors counted the vehicles and persons coming into and going out each gate of the building, at the intervals of 15 minutes during hours of operation on one weekday (either on Tuesday, Wednesday, or Thursday).

In the PCS, the surveyors counted the number of persons coming into and going out each entrance and exit of the building for pedestrians, at the intervals of 15 minutes during hours of operation on one weekday (either on Tuesday, Wednesday, or Thursday).

In the ISFU, the surveyors randomly selected interviewees at the same location and duration as the PCS, and then conducted interviews about their household and personal attributes, and trip information. The sampling rate of the ISFU is 5% of employees and 5% of visitors on the survey date.

(2) Survey Location

To understand trip rates by facility type, the TGS was conducted at a total of twenty major office buildings, shopping malls, supermarkets and traditional markets in the Study Area. The survey locations are shown in Table 2.2.12.

Table 2.2.12 Summary of Interview Survey of Trip Generation Survey (TGS)

No.	Facility Type	Location Name
1	Office building	Botour
2		Rawbank
3		Gallerie du Centenaire (Pharmabel)
4		Orange RDC
5		Ecobank / Icon Tower
6		Total RDC
7		Procredit
8		Vodacom
9		Pain Victoire
10		CCIF
11	Shopping malls/ Supermarkets	Le Premier Shopping Mall
12		GG Mart
13		Shoprite
14		Monishop
15		Hasson Africa
16		Kin Marche
17	Traditional markets	Grand Marche
18		Gambela Market
19		Liberte Market
20		UPN Market

Source: The Study Team

(1) Basic Analysis and Major Findings

Table 2.2.13 shows a summary table of the net trip rate when arriving at each survey location by trip purpose. The results indicated that there was almost no tendency of the trip rate depending on the type of survey location.

Table 2.2.13 Summary on Net Trip Rate when Arriving at Each Survey Location

No.	Facility Type	Survey Location	Net Trip Rate when Arriving at Each Survey Location						
			To Work	To School	Shopping	Private	Other	Business	Total
1	Office Building	Botour	0.22	0.00	0.26	0.18	0.02	0.35	1.03
2		Rawbank	0.13	0.00	0.05	0.48	0.16	0.18	1.00
3		Gallerie du Centenaire	0.18	0.16	0.09	0.42	0.14	0.21	1.19
4		Orange RDC	0.49	0.07	0.18	0.07	0.35	0.18	1.35
5		Ecobank / Icon Tower	0.23	0.00	0.00	0.33	0.20	0.27	1.03
6		Total RDC	0.56	0.02	0.22	0.07	0.00	0.15	1.03
7		Procredit	0.66	0.00	0.00	0.01	0.00	0.32	1.00
8		Vodacom	0.34	0.02	0.02	0.26	0.00	0.37	1.00
9		Pain Victoire	0.20	0.06	0.44	0.12	0.00	0.28	1.10
10		CCIF	0.10	0.00	0.00	0.60	0.00	0.30	1.00
11	Shopping Malls/ Supermarkets	Le Premier Shopping Mall	0.23	0.05	0.38	0.24	0.00	0.21	1.10
12		GG Mart	0.21	0.00	0.19	0.20	0.08	0.34	1.01
13		Shoprite	0.15	0.04	0.40	0.21	0.02	0.27	1.08
14		Monishop	0.48	0.08	0.26	0.16	0.09	0.34	1.40
15		Hasson Africa	0.64	0.05	0.26	0.00	0.02	0.02	1.00
16		Kin Marche	0.03	0.03	0.77	0.16	0.00	0.05	1.04
17	Traditional Market	Grand Marche	0.09	0.04	0.51	0.13	0.00	0.23	1.00
18		Gambela Market	0.56	0.02	0.25	0.06	0.00	0.10	1.00
19		Liberte Market	0.13	0.02	0.52	0.11	0.03	0.22	1.02
20		UPN Market	0.22	0.19	0.37	0.20	0.01	0.16	1.15

Source: The Study Team

Table 2.2.14 and Table 2.2.15 show the number of outbound / inbound pedestrians and vehicles at each survey location, respectively. The tables indicates that the numbers of pedestrians and vehicles at the local markets such as Grand Marche and Liberte Market are high, which implies the heavy dependence of residents on informal sectors in the Study Area.

Table 2.2.14 Summary on Number of Outbound and Inbound Pedestrians

No.	Facility Type	Survey Location	No. of Outbound			No. of Inbound		
			Cycle	Pedestrian	Total	Cycle	Pedestrian	Total
1	Office Building	Botour	0	9,286	9,286	0	9,578	9,578
2		Rawbank	0	1,297	1,297	0	1,304	1,304
3		Gallerie du Centenaire	0	1,543	1,543	0	1,641	1,641
4		Orange RDC	0	787	787	0	906	906
5		Ecobank / Icon Tower	0	797	797	0	822	822
6		Total RDC	0	221	221	0	227	227
7		Procredit	0	454	454	0	472	472
8		Vodacom	0	933	933	0	947	947
9		Pain Victoire	0	1,812	1,812	0	1,965	1,965
10		CCIF	0	73	73	0	77	77
11	Shopping Malls/ Supermarkets	Le Premier Shopping Mall	0	2,680	2,680	0	2,733	2,733
12		GG Mart	0	2,601	2,601	0	2,631	2,631
13		Shoprite	0	2,914	2,914	0	2,903	2,903
14		Monishop	0	726	726	0	738	738
15		Hasson Africa	0	2,491	2,491	0	2,513	2,513
16		Kin Marche	0	2,376	2,376	0	2,387	2,387
17	Traditional Market	Grand Marche	0	78,665	78,665	0	93,495	93,495
18		Gambela Market	0	52,400	52,400	0	63,837	63,837
19		Liberte Market	0	95,054	95,054	0	93,647	93,647
20		UPN Market	0	28,105	28,105	0	28,734	28,734

Source: The Study Team

Table 2.2.15 Summary on Number of Outbound and Inbound Vehicles

No.	Facility Type	Survey Location	No. of Outbound					No. of Inbound				
			MC	Car/Van	Truck	Other	Total	MC	Car/Van	Truck	Other	Total
1	Office Building	Botour	8	230	24	0	262	10	225	40	0	275
2		Rawbank	36	139	85	0	260	36	138	86	0	260
4		Orange RDC	6	37	6	0	49	6	48	9	0	63
5		Ecobank / Icon Tower	9	117	10	0	136	12	163	7	0	182
6		Total RDC	2	42	20	0	64	0	71	23	0	94
7		Procredit	3	360	111	0	474	3	484	156	0	643
8		Vodacom	1	266	48	0	315	1	268	92	0	361
9		Pain Victoire	74	203	188	16	481	90	206	238	13	547
11	Shopping Malls/ Supermarkets	Le Premier Shopping Mall	11	266	35	0	312	9	270	38	0	317
12		GG Mart	40	526	173	0	739	45	527	177	0	749
13		Shoprite	186	1,836	238	1	2,261	133	1,970	156	4	2,263
14		Monishop	57	783	85	0	925	57	793	87	0	937
16		Kin Marche	141	328	82	3	554	141	328	82	3	554
19	Traditional Market	Liberte Market	115	937	501	0	1,553	940	724	236	0	1,900

Note: There are not specific gates for vehicles at the survey locations of No. 10, 15, 17, 18 and 20.

Source: The Study Team

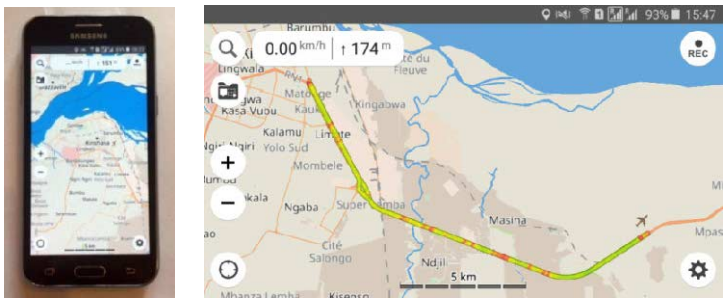
2.2.7 Travel Speed Survey (TSS)

(1) Survey Method

The purpose of the TSS is to identify congestion bottlenecks and visualize the travel time and speed, by utilizing vehicles equipped with GPS logger of major arterial roads in Kinshasa City. The survey was conducted by a set of a surveyor and a driver with a vehicle equipped with a GPS logger to collect the data of location (longitude and latitude) and time.

- Survey dates: 8th to 19th June, 15th August, 21st Sept. in 2017, four weekdays per route
- Survey hours: 14 hours per day (6:00 to 13:00, 14:00 to 21:00)

Based on the collected data, the travel speeds are calculated and visualized on a map. Road conditions that affect the travel speed were observed by surveyors to find out the main factors of driving speed.



Source: The Study Team

Figure 2.2.48 GPS Logger (smart phone) and Example of GPS Log

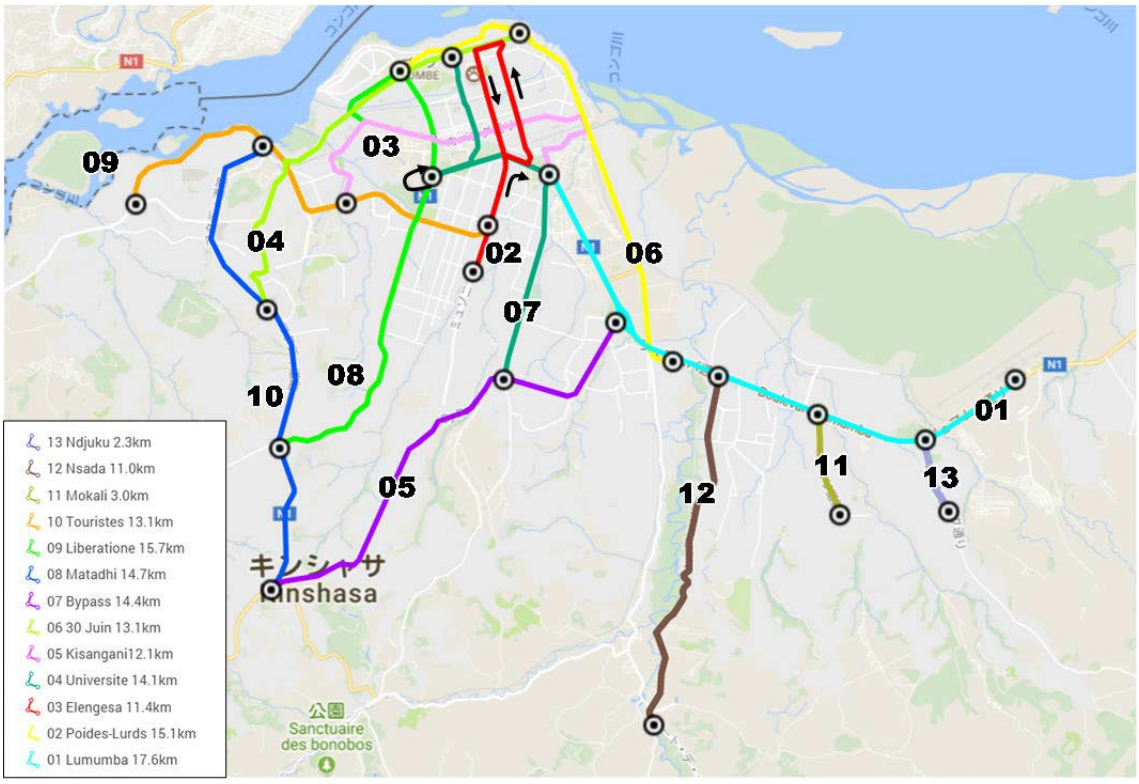
(2) Survey Route

The Travel Speed Survey was conducted along the routes depicted in Table 2.2.16 and Figure 2.2.49.

Table 2.2.16 Routes of Travel Speed Survey

Route no. and Name	Name of Roads	Distance (km)
R01 Lumumba	Lumumba Bld.	17.6km
R02 Elengesa	Elengesa Ave., Kasa-vubu Ave., Jason Sendwe Bld., Luambo Makiadi Ave., 30 Juin Bld. Kasa-vubu Ave., Elengesa Ave.	11.4km
R03 Kisangani	Kisangani Ave., l'Hospital Ave., OUA Ave, Sergent Moke Ave., l'Aerodrome Ave., Militant Ave., Lumumba Ave.	12.1km
R04 30 Juin	Nguma Av.e, Col Monjiba Ave., 30 Juin Bld.	13.1km
R05 Bypass	Bypass	14.4km
R06 Congo-Japon	Congo-Japon Bld., Wagenia Ave., Col Lukusa Ave., Justice Ave.	15.1km
R07 Universite	University Ave., Jason Sendwe Bld., Triompha Bld., Huileries Ave.	14.1km
R08 Liberatione	Liberation Ave., Justice Ave.	15.7km
R09 Touristes	Tourism Ave., Kasa-vubu Ave.	13.1km
R10 Matadhi	Rte Matadi, Montagne Ave.	14.7km
R11 Mokali	Mokali Ave.	3.0km
R12 Nsada	Nsada Ave.	11.0km
R13 Ndjuku	Ndjuku Ave.	2.3km

Source: The Study Team



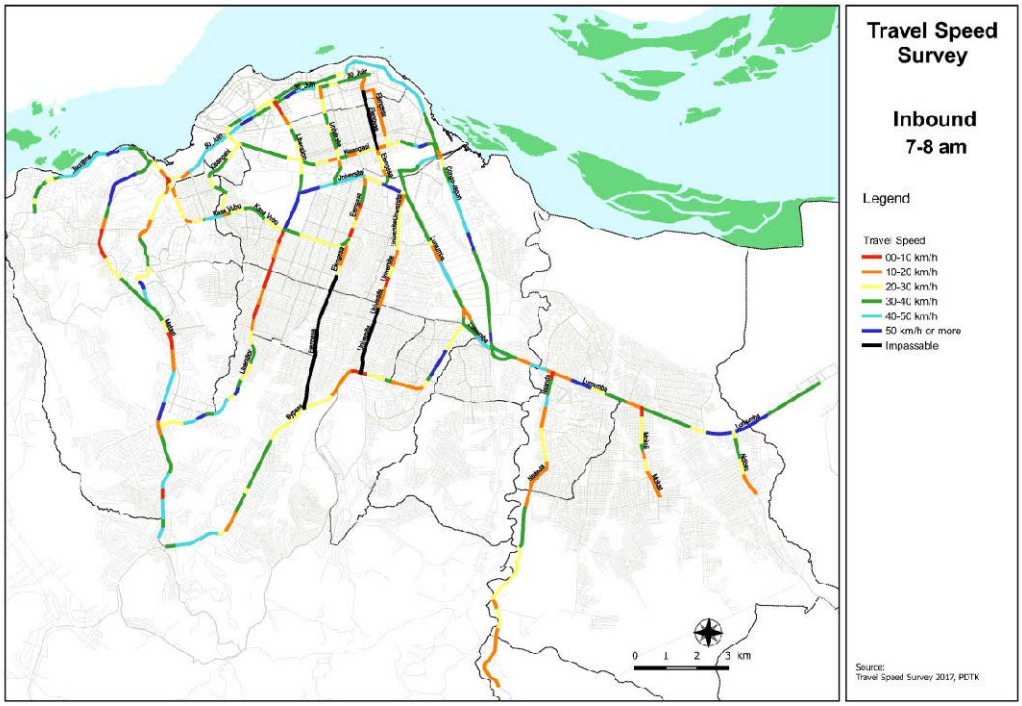
Source: The Study Team

Figure 2.2.49 Survey Routes of Travel Speed Survey (TSS)

(3) Basic Analysis and Major Findings

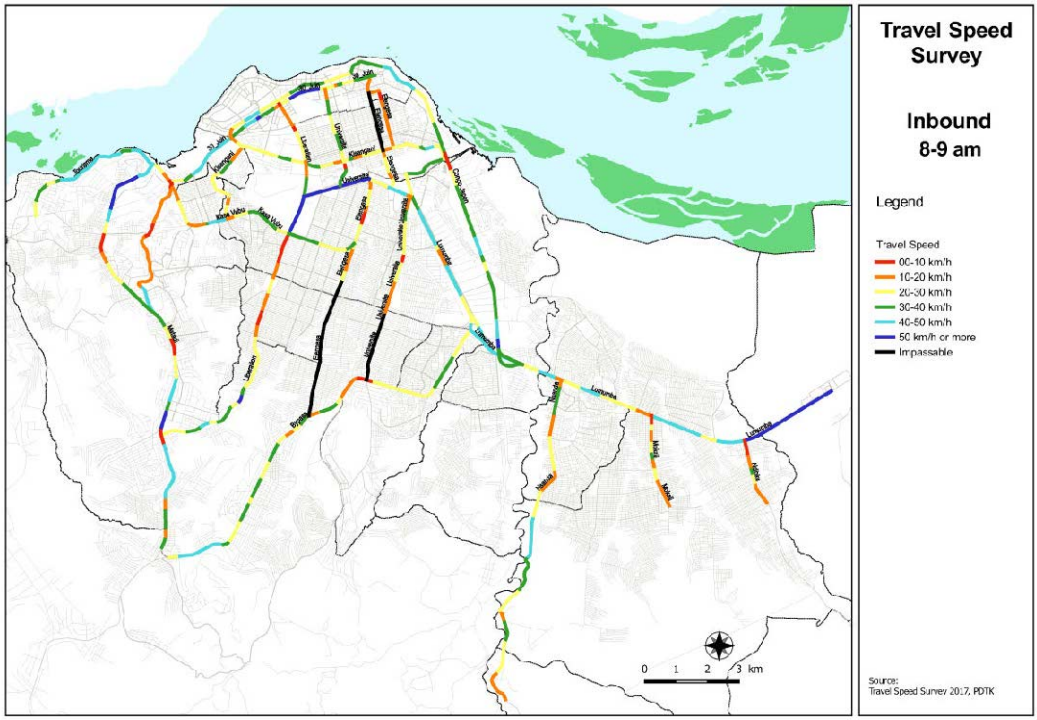
a) Travel Speed by Road Section

Figure 2.2.50 through Figure 2.2.53 show the result of average travel speed during the morning and evening peak hours. Travel speeds slow down around markets, major intersections that have a transit terminal for taxies and buses, and roads with poor surface. For instance, the intersections at Kintambo Magasin (30 Juin Boulvard - Kasa-vubu Avenue, etc.) and Round-point Ngaba (University Avenue - Bypass) become bottlenecks of traffic flow.



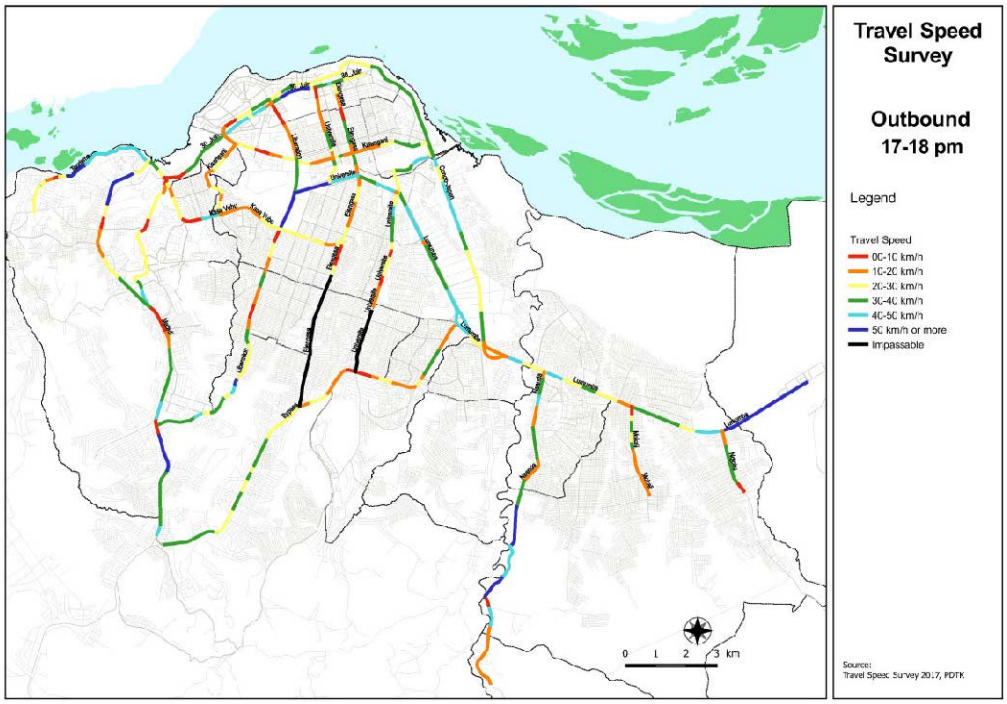
Source: The Study Team

Figure 2.2.50 Average Travel Speed of Morning Peak (Inbound, 7-8AM)



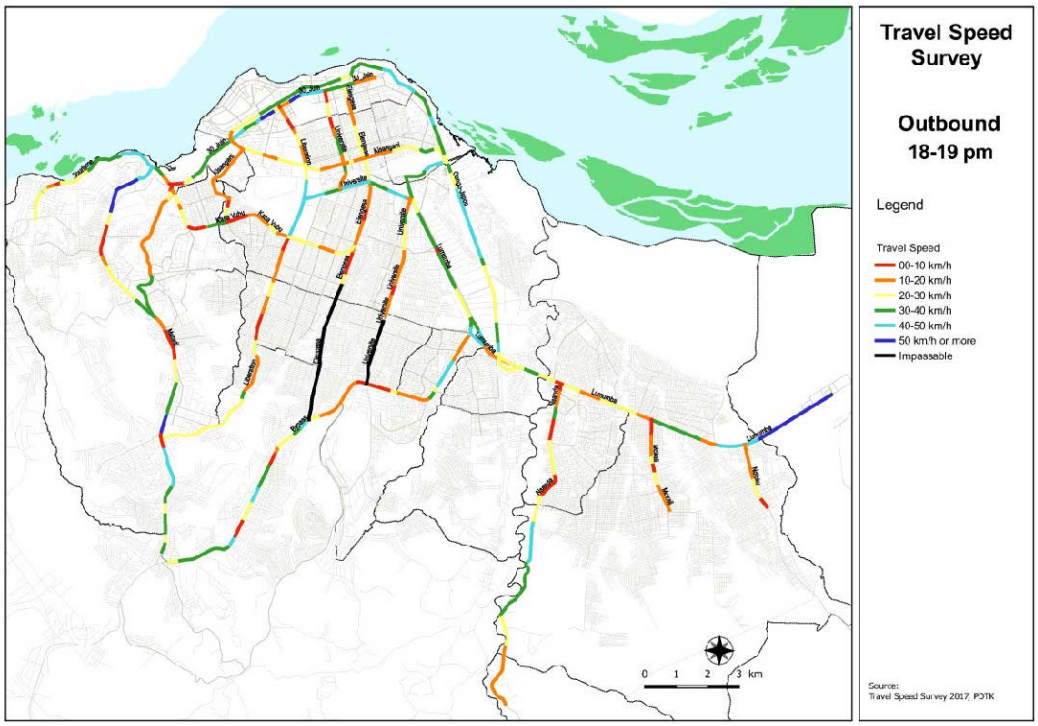
Source: The Study Team

Figure 2.2.51 Average Travel Speed of Morning Peak (Inbound, 8-9AM)



Source: The Study Team

Figure 2.2.52 Average Travel Speed of Evening Peak (Outbound, 5-6PM)



Source: The Study Team

Figure 2.2.53 Average Travel Speed of Evening Peak (Outbound, 6-7PM)

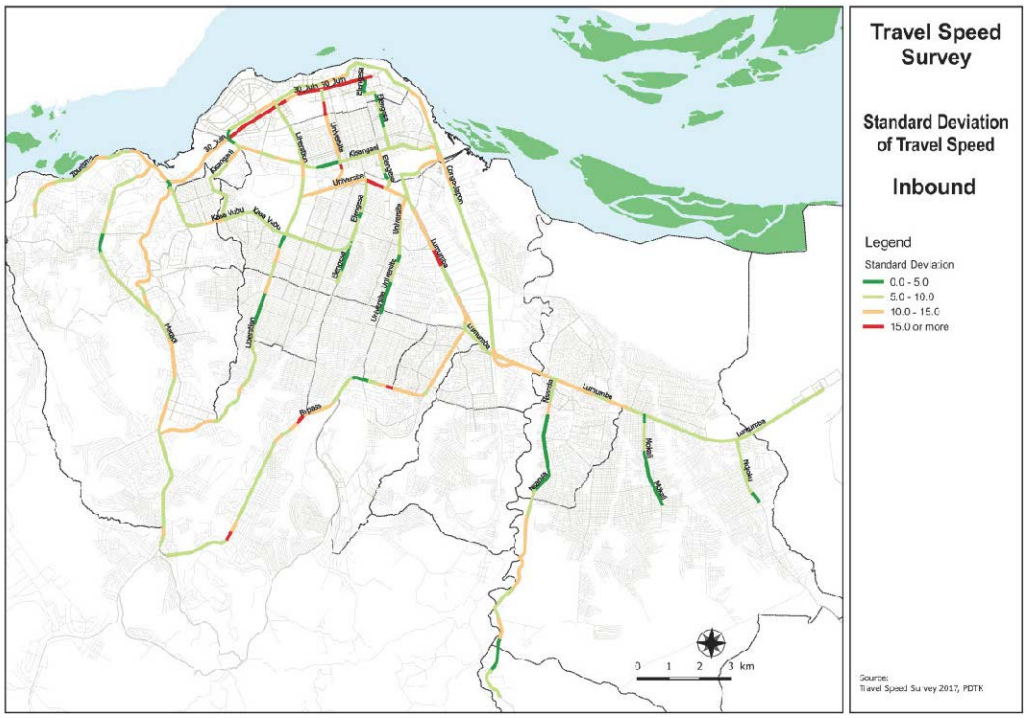
Features of each route are described as follows.

R01 Lumumba:	Relatively good travel speeds; there are markets and intersections that slow down vehicles.
R02 Elengesa:	Slow travel speed, due to poor road conditions.
R03 Kisangani:	Slow travel speed; Kabinda Ave, Oua Ave have a slow travel speeds due to poor road conditions and numerous pedestrians.
R04 30 Juin:	Slow travel speeds at some intersections in the evening and daytime.
R05 Bypass:	Slow travel speeds due to poor road conditions; area around Point Ngaba is always crowded with people and minibuses.
R06 Congo-Japon:	Fairly good travel speeds; slow travel speed at railway crossing.
R07 Universite:	Very slow travel speeds particularly in the south section due to poor road conditions.
R08 Liberatione:	Slow travel speeds at crossing with 30 Juin Bld., around market, and around UPN.
R09 Touristes:	Slow travel speeds especially at around a market area in Bumbu Commune.
R10 Matadhi:	Kintambo Magasins is always crowded.
R11 Mokali:	Slow travel speeds due to poor road conditions and roadside shops.
R12 Nsada:	Slow travel speeds due to poor road conditions and roadside shops.
R13 Ndjuku:	Slow travel speeds due to poor road conditions.

c) Reliability of Travel Time

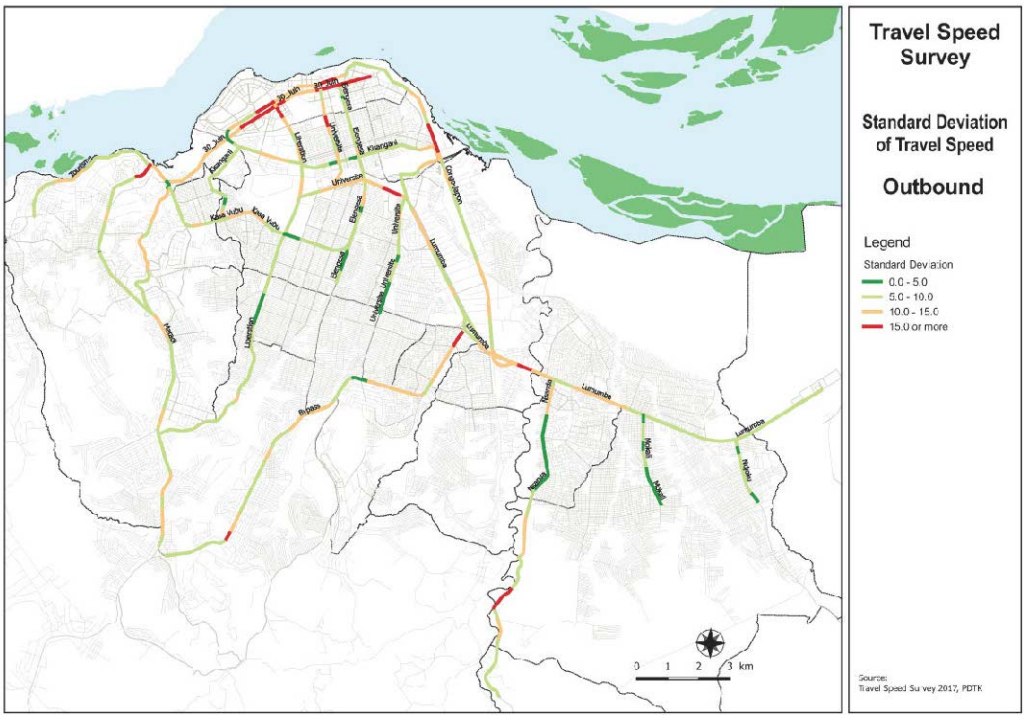
Travel speed is the primary concern for road users to choose their route, but the reliability of travel time is also an important factor. The standard deviation of travel time can be used as an indicator for investigating the reliability of a road network. Figure 2.2.54 and Figure 2.2.55 illustrate the reliability of roads by standard deviation indicator. The road sections in red, which have a high numerical value, mean a poor reliability of travel time.

For instance, 30 Juin Boulevard can be regarded as a road with poor reliability due to the travel speed being unstable and dispersed widely. Considering that the current traffic volume of 30 Juin Boulevard does not exceed its capacity, there are other obstacles that reduce its capacity, such as parked vehicles along roads and intersections without traffic lights. This implies the unstable travel time is due to the traffic congestion, which can be improved if traffic signals work properly at intersections.



Source: The Study Team

Figure 2.2.54 Reliability of Travel Time (Inbound)



Source: The Study Team

Figure 2.2.55 Reliability of Travel Time (Outbound)

2.2.8 Stated Preference Survey (SPS)

(1) Survey Method

The SPS was conducted through on-site interviews with visitors and employees at targeted survey locations. The field survey was implemented during weekdays from Monday to Friday to capture the daily transport activities of the respondents. The surveyors were requested to conduct interviews with randomly selected respondents in terms of their social status such as age, gender and household income, in order to avoid sampling bias.

For the development of a SP-based mode choice model, the survey forms of the SPS were divided into 1) General information and 2) Stated preference by three trip purposes, as shown in Table 2.2.17.

The part of 2) Stated preference was especially designed to figure out the current transport mode of the respondents, and their willingness to pay for public transport. The willingness is a modal choice behaviour under the hypothetical situation in which new transportation systems are shown to be respondent based on the main modes of transport they currently use.

Table 2.2.17 Survey Contents of Stated Preference Survey

Form	Contents
1. General Information	- Data and location to be surveyed - Household Information ・ Location of Household (Commune) ・ Number of household members ・ Vehicle ownership (Car / Motorcycle) ・ Household monthly income - Personal Information ・ Gender / Age ・ Relationship to head of household ・ Social status (Worker, student, retired, unemployed, etc.) ・ Employment status ・ Industry/Sector
2-1. Stated Preference to Work/School trips	- Name and location of a typical destination (Commune) - Current travel behaviour ・ Travel time ・ Transport expense ・ Transport mode / Time(s) of transfer - Stated preference for selecting a new transport mode under hypothetical situations
2-2. Stated Preference to private purposes	- Same as above
2-3. Stated Preference to business trips	- Same as above

Source: The Study Team

(2) Survey Coverage and Sampling

The survey was conducted at major transit terminals and commercial centres in the Study Area, as listed in Table 2.2.18. These locations were selected to capture respondents who are potential users of new public transport with a wide range of social status, such as income and their trip characteristics such as current mode of transport and trip purpose, to avoid biased sampling.

The target number of effective samples was 3,000 individual respondents who are aged five years or over.

Table 2.2.18 Survey Locations of Stated Preference Survey

No.	Location Name	Type	No. of Effective Sample
1	Gare Central (Kinshasa Central Station)	1. Bus terminal	200
2	Rond point UPN		200
3	Rond point Victoire		200
4	Place Sainte Therèse		200
5	Arret 13è rue Limete		200
6	Arret Saint Raphaèl		200
		Sub total	1200
7	Access Bank	2. Office building	50
8	Immeuble Botour		50
9	Futur Tower		50
10	Gallerie presidentielle		50
11	Immeuble Congo Futur		50
12	Orange RDC		50
		Sub total	300
13	Le premier shopping Mall	3. Shopping mall/ Super market	200
14	Kin Plaza		200
15	SHOPRITE		200
16	Hasson et Frere		200
17	GG Mart		200
		Sub total	1000
18	Grand Marché	4. Traditional market	200
19	Liberté		200
20	Gambela		100
		Sub total	500
Total Number of Effective Samples			3000

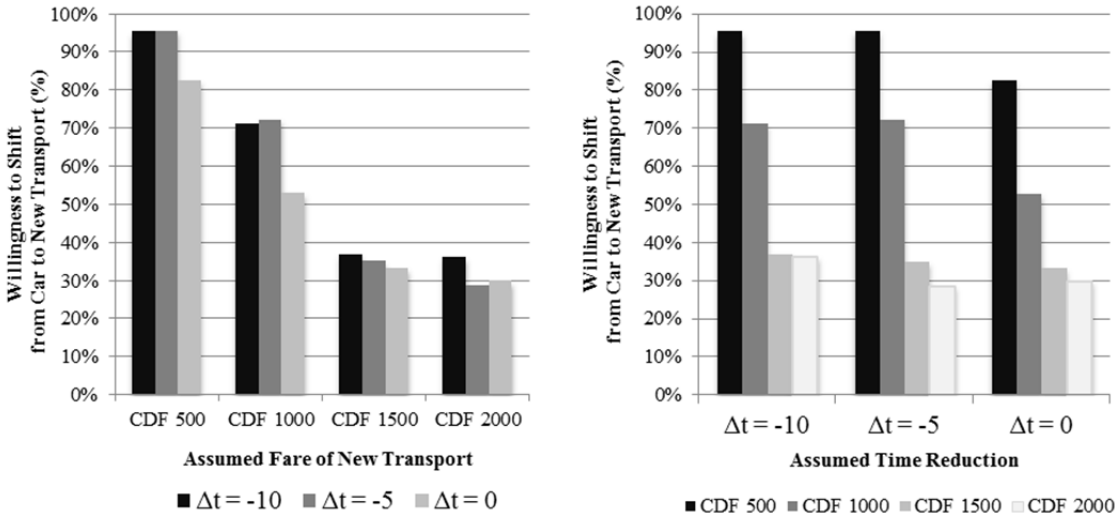
Source: The Study Team

(3) Basic Analysis and Major Findings

Figure 2.2.56 and Figure 2.2.57 show the ratio of willingness to modal shift from car and motorcycle to new public transport, respectively. It shows that the assumed condition of new public transport fares could be more critical to nudge people in the Study Area into their modal shift than that of travel time reductions.

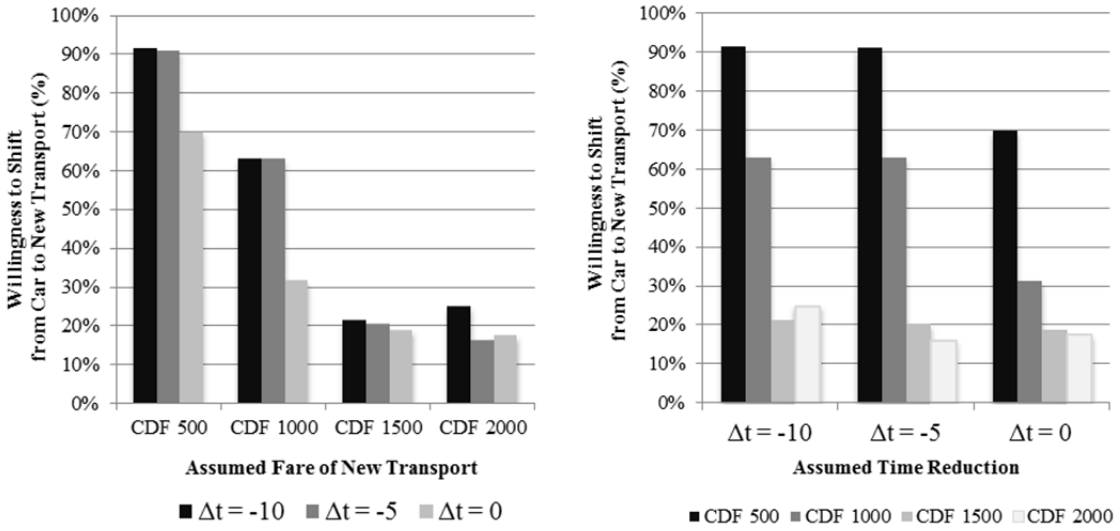
In particular, if the new public transport with a fare of CDF 500 per trip enabled the persons to enjoy some certain of travel time reduction compared to the cars and motorcycles, more than 90% of them would be expected to shift to the new public transport. Even if their travel time was not reduced, 80% and 70% of them would shift from cars and motorcycles, respectively.

With the assumed fare of CDF 1,500 and over, the modal shift to the new public transport could be limited at around only 30% from cars and 20% from motorcycles.



Source: The Study Team

Figure 2.2.56 Willingness to Shift from Car to New Public Transport



Source: The Study Team

Figure 2.2.57 Willingness to Shift from Motorcycle to New Public Transport

2.2.9 Road Inventory Survey (RIS)

(1) Survey Method

The RIS includes 1) office work based on satellite images (Pléiades) and collected documents, and 2) field surveys.

The office work is being conducted based on satellite images (Pléiades) with a resolution of 50cm taken from 2014 to 2017, and collected data from relevant institutions such as road lists of primary, secondary, and tertiary roads from OVD (*Office des Voiries et Drainages* / Office of Roads and Drainage). The jurisdiction of each roads and road distances were confirmed and updated by technical collaboration with OR and OVD. Then, the surveyors identify and input the width of the right of way, width of the carriage way, pavement type and road class in the office, and update through the field surveys.

After the office work, the surveyors verify the input data of the office work in the field, and surveyed inventory information in detail such as drainage type, drainage width, pavement type, pavement width, shoulder width, median width, pavement condition, roadside light, and so on.

Source: The Study Team

Figure 2.2.58 Photo of Road Inventory Survey (Surveyor's Training)

(2) Target Roads

To develop the road network for transport model, the target roads of the RIS considered three categories: 1) Road class (national, provincial, primary and secondary roads), 2) Pavement condition (Asphalt or Concreate), and 3) Road width (more than two lanes). Consequently, the total distance of target roads becomes 794.22 km, out of 3,551.14 km for all roads in the Study Area.

(3) Basic Analysis and Major Findings

a) Administrative Classification

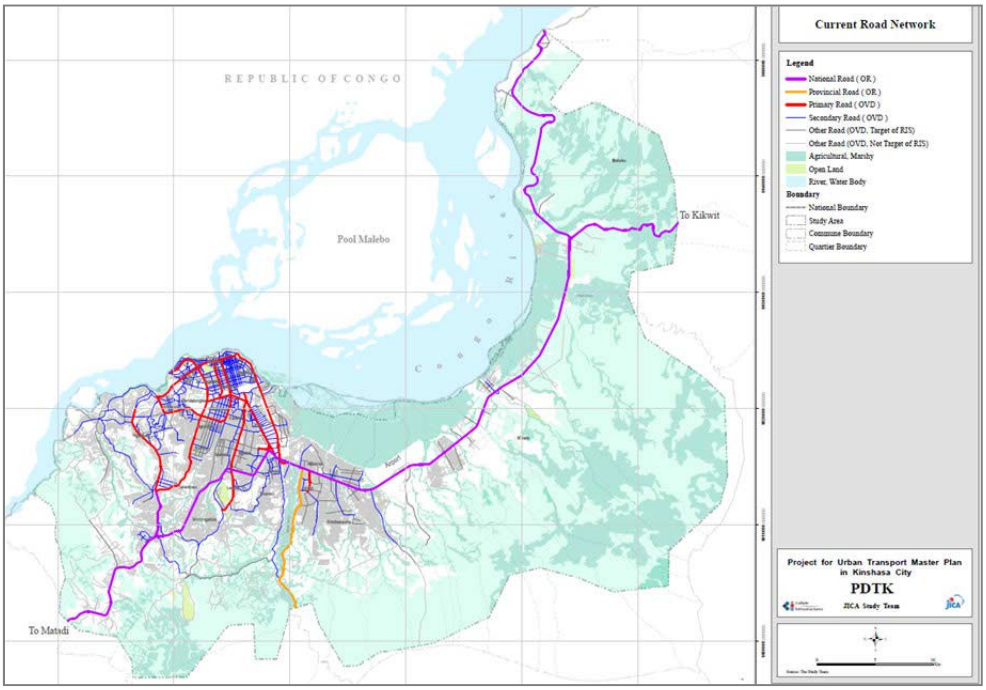
Road length and proportion by administrative classification are shown in Table 2.2.19, Figure 2.2.59, and Figure 2.2.60.

The national and provincial roads under jurisdiction by OR in Study Area are 108.75 km (2.50 %) and 13.45 km (0.31%), respectively. Roads under OR is only 122.20 km (2.81%) in the Study Area. Road length in the Study Area is shorter than of Kinshasa City because the Study Area is smaller than the area of Kinshasa City. On the other hand, the total road length under OVD in the Study Area is 4,226.17 km (97.19%), comprised of 83.03 km (1.91 %) of primary roads, 332.74 km (7.65%) of secondary roads, 259.26 km (5.96%) of other target roads and 3,551.14 km (81.67%) of untargeted roads.

Table 2.2.19 Administrative Classification in Study Area

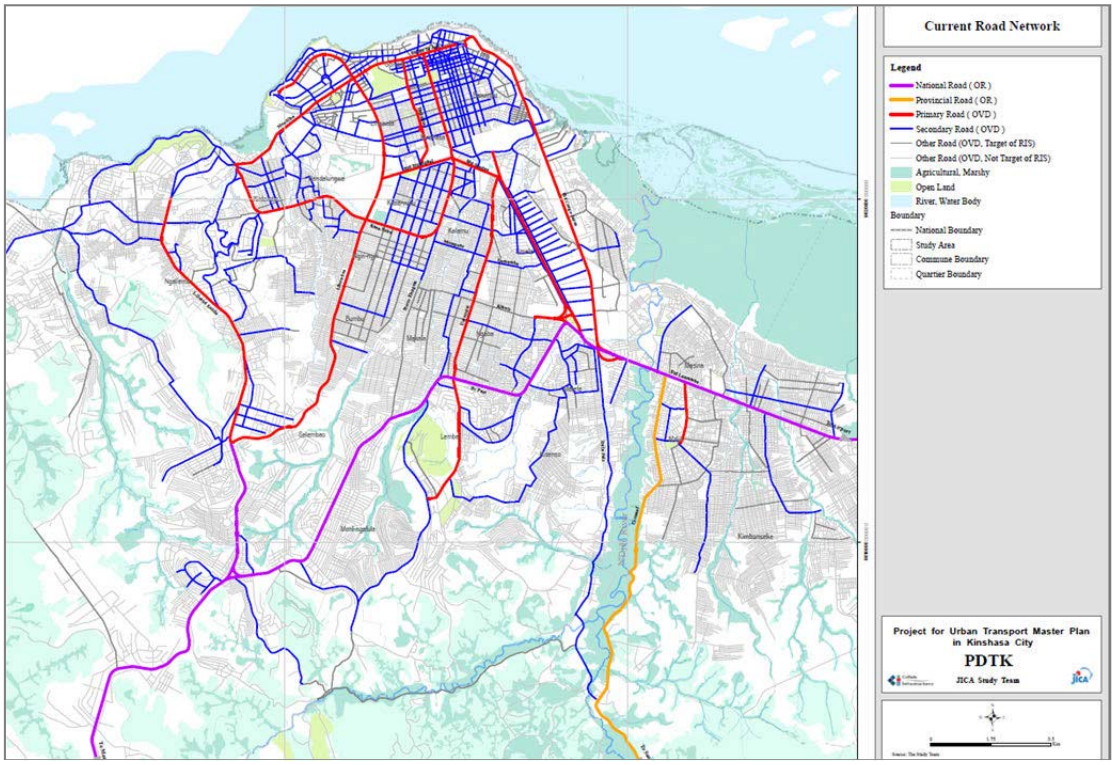
Commune	Target Road					Untargeted Road	Total
	National Road	Provincial Road	Primary Road	Secondary Road	Other Road		
Jurisdiction	**OR**	**OR**	**OVD**	**OVD**	**OVD**	**OVD**	
Length (km)	108.75	13.45	83.03	332.74	259.26	3,551.14	4,348.37
Proportion (%)	2.50	0.31	1.91	7.65	5.96	81.67	100.00

Source: The Study Team



Source: The Study Team

Figure 2.2.59 Current Road Network in Study Area (Whole Area)



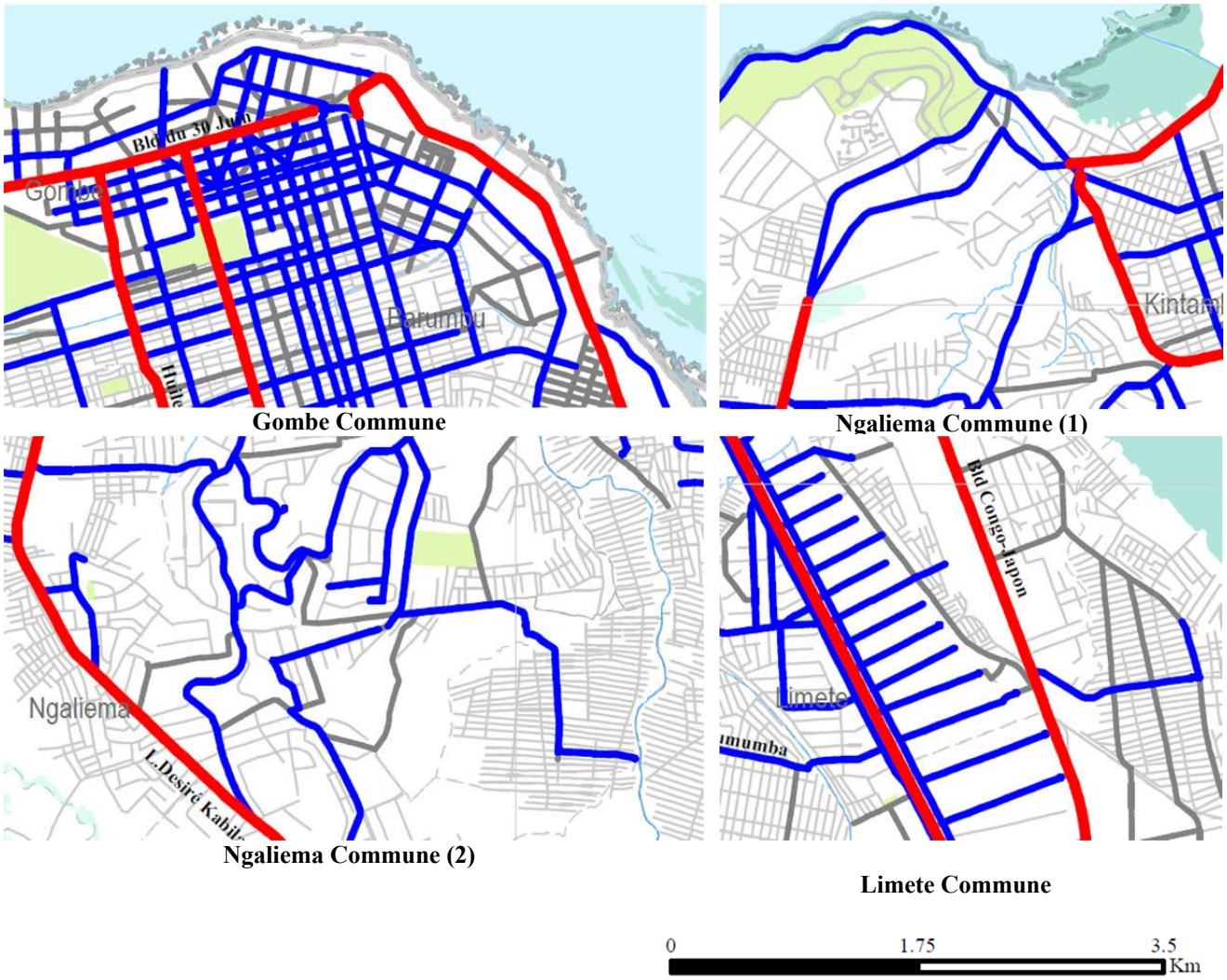
Source: The Study Team

Figure 2.2.60 Current Road Network in Study Area (Western Area)

The main three issues of the road network in the Study Area can be summarized as follows:

- Discontinuous Primary road network,
- Disconnected (dead-end) Secondary road network, and
- Unbalanced (dense and coarse) network density.

Such specific places are shown in Figure 2.2.61. Moreover, it is considered that these main reasons are determined not by the classification of functional hierarchy, but by the existing road width and operational situation.



Source: The Study Team

Figure 2.2.61 Issues of Functional Road Network in Study Area

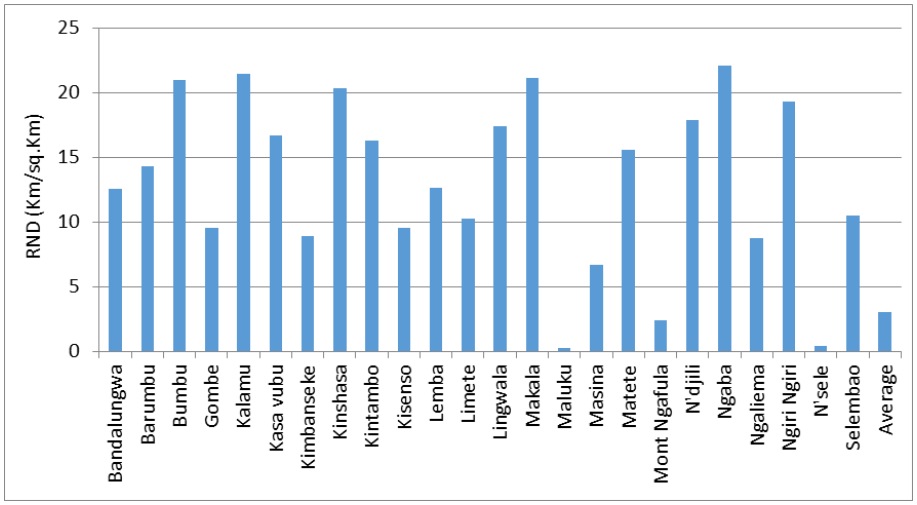
Furthermore, local roads are disconnected everywhere by medium and small rivers. A few specific samples are shown in Figure 2.2.62.

Source: The Study Team, elaborated based on Google Earth Image© 2018 CNES / Airbus

Figure 2.2.62 Example of Disconnected Road Network in Study Area

Road Network Density

The Road Network Density (RND) in the Study Area is shown in Figure 2.2.63. The RND in the Study Area is 3.03 km/sq. km, which is a very low density. However, some communes are above 20 km/sq. km and high, namely the Bumbu, Kalamu, Kinshasa, Makala and Ngaba Communes, but the road length is still not enough compared with other developed cities in the world.



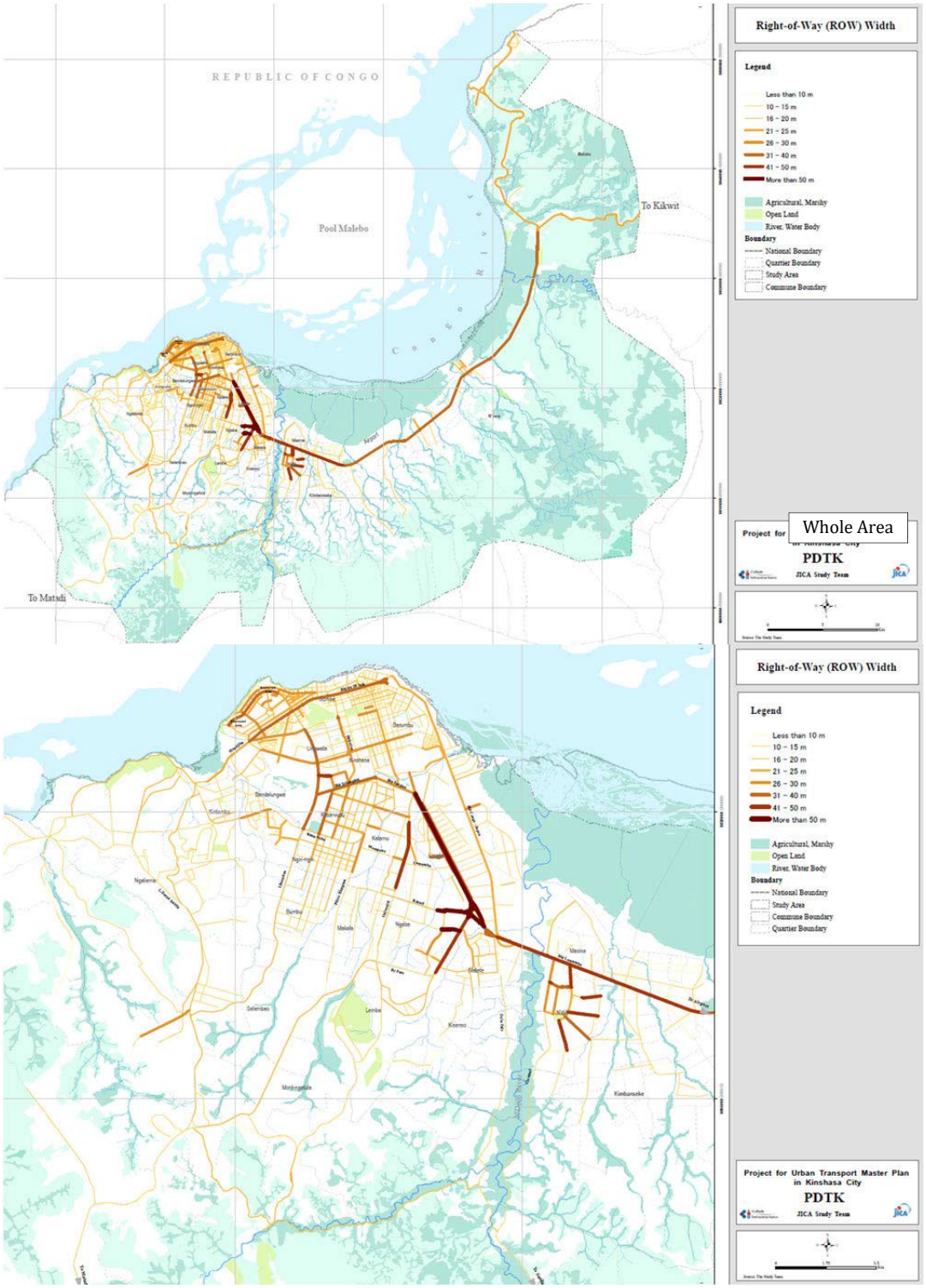
Source: The Study Team

Figure 2.2.63 Road Network Density in Study Area

b) Road Area Ratio

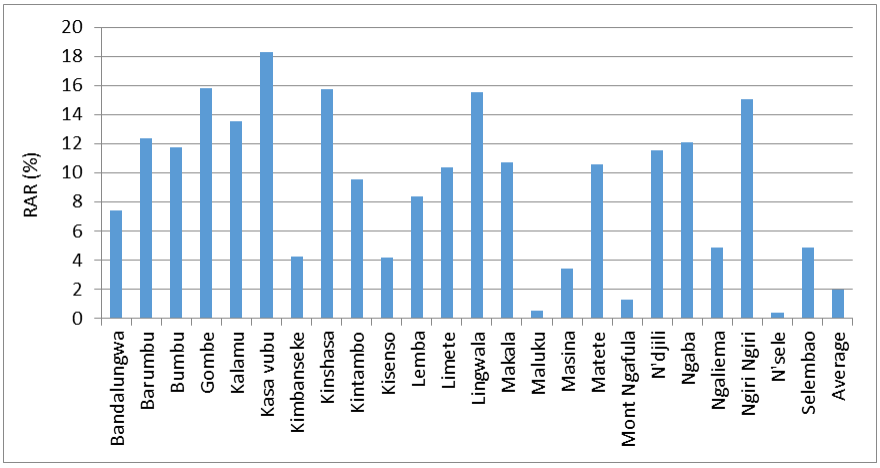
The current ROW (right-of-way) width for target roads in the Study Area is shown in Figure 2.2.64. Lumumba Bld., 30 Juin Bld., and some limited roads have wide ROW. However, there is no continuity, and land acquisition had not been implemented in the plan.

The estimated Road Area Ratio (RAR) in the Study Area is shown in Figure 2.2.65, assuming that the ROW of untargeted road is 4 meters. The RAR in Study Area is 2.00%, which is very low. The RAR of all communes are less than 20%, but some communes are above 15% and are sufficiently high, namely the Gombe, Kasa-vubu, Kinshasa, Lingwala and Ngiri-ngiri communes, but the road length is still not enough compared with other developed cities in the world..



Source: The Study Team

Figure 2.2.64 Current Right-of-Way Width for Target Roads in Study Area



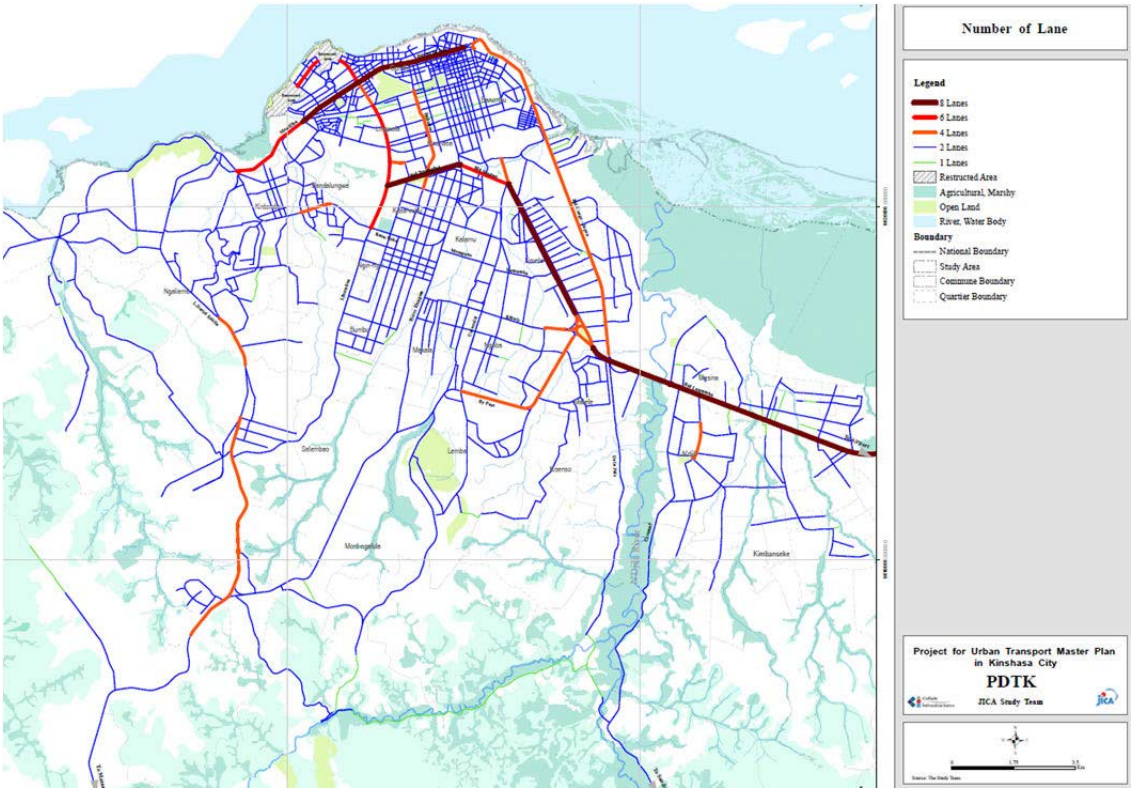
Source: The Study Team

Figure 2.2.65 Road Area Ratio in Study Area

c) Number of Lanes

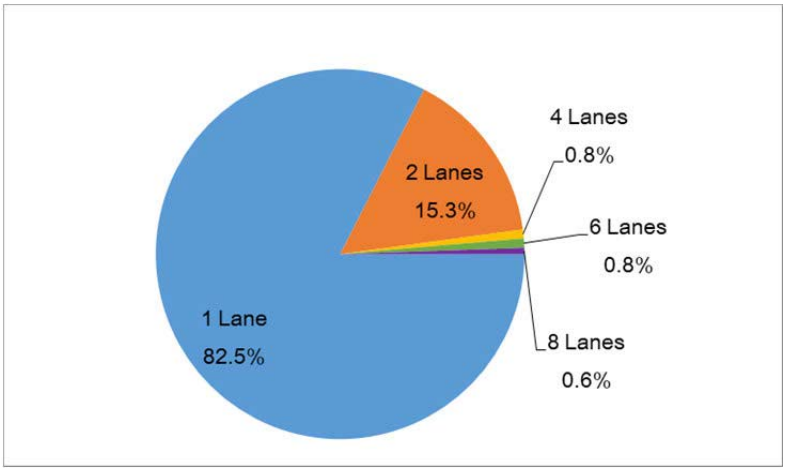
The current number of lanes for target roads in the Study Area is shown in Figure 2.2.66. Lumumba Bld. (western section), 30 Juin Bld., and Triomphal Bld. have eight lanes. However, roads with four or more lanes are limited.

The estimated number of lanes in the Study Area is shown in Figure 2.2.67, assuming that the number of lanes for untargeted road is 1 lane. Roads with four or more lanes are only 2.1%. Two-lane roads are 15.3%, and more than 80% are single lane roads.



Source: The Study Team

Figure 2.2.66 Current Number of Lanes in the Study Area



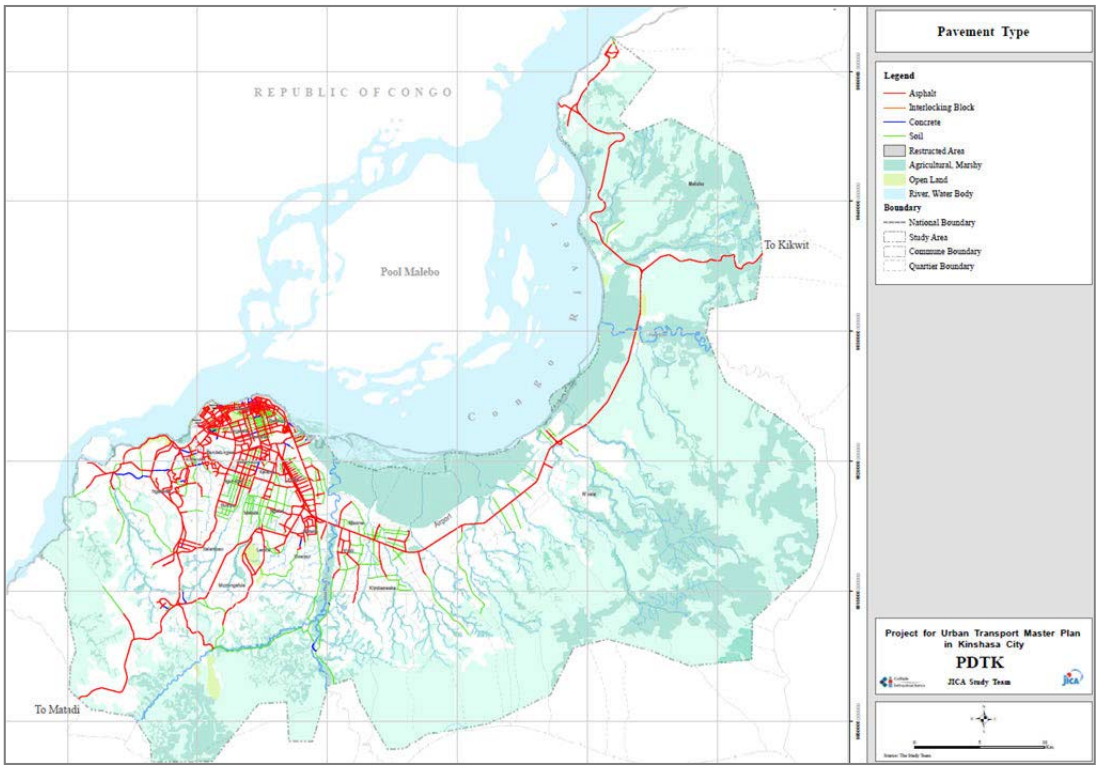
Source: The Study Team

Figure 2.2.67 Component of Number of Lanes in the Study Area

e) Types of Pavement

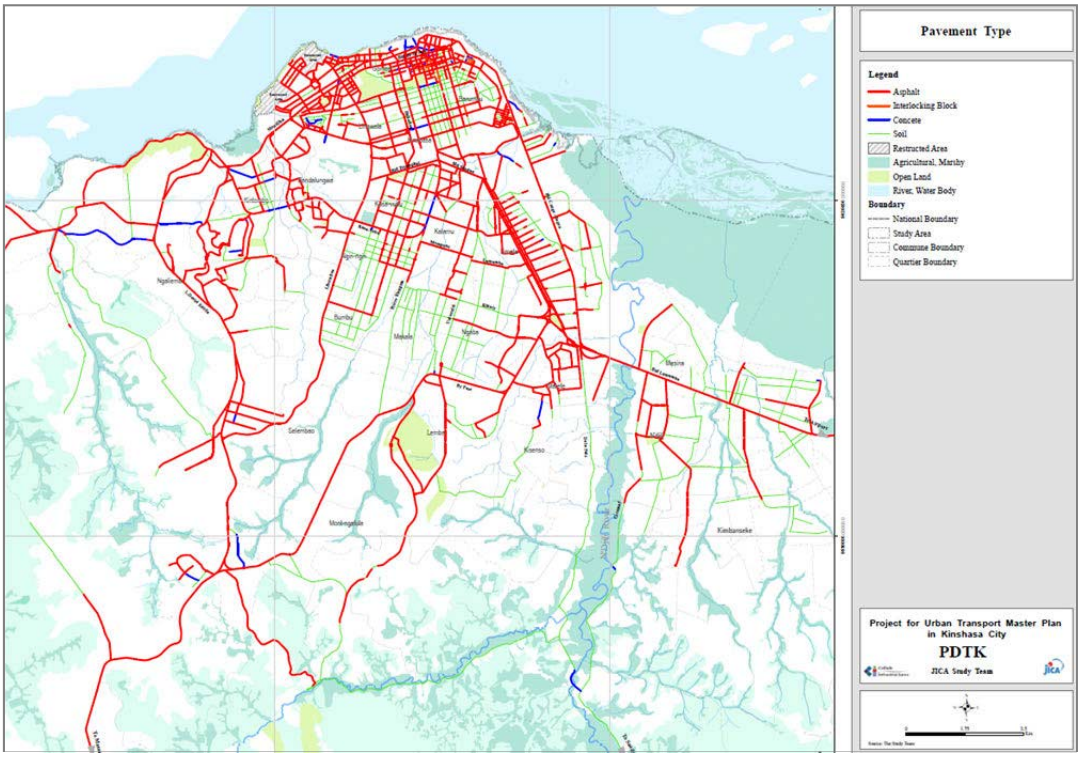
The current pavement types for target roads in the Study Area are shown in Figure 2.2.68 and Figure 2.2.69. The surfaces of the main roads are paved, but the unpaved surfaces for target roads

are mainly located in the Kisenso, Makala and Ngaba communes. The component of pavement types for target roads in the Study Area is shown in Figure 2.2.70, and consists of 498.77 km of AC (asphalt concrete, 62.8%), 19.80 km of PCC (portland cement concrete, 2.5%), 2.35 km of interlocking block (0.3%), and 273.29 km (34.4%) of soil. Even on target roads, the paving rate is as low as 65.6%.



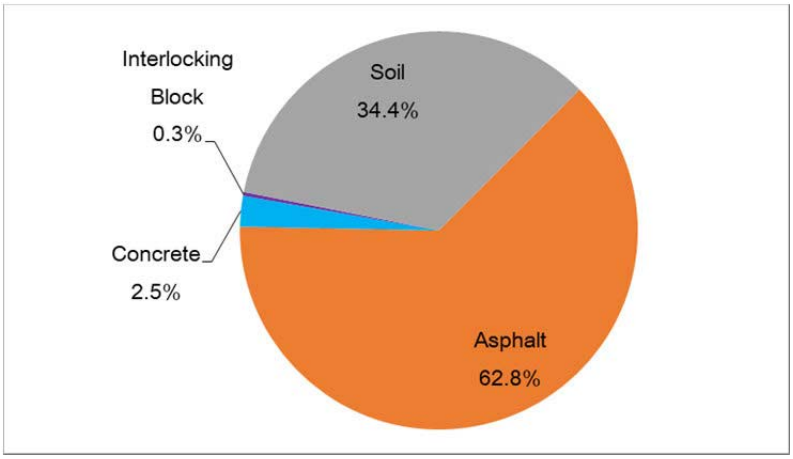
Source: The Study Team

Figure 2.2.68 Current Pavement Types for Target Roads in Study Area (Whole Area)



Source: The Study Team

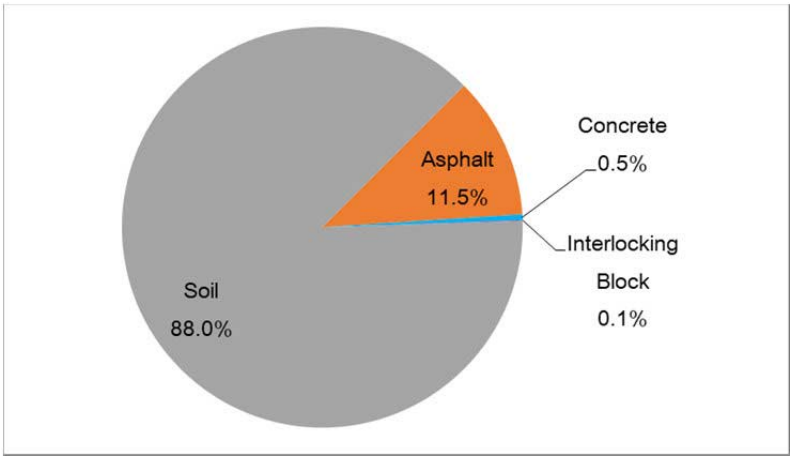
Figure 2.2.69 Current Pavement Types for Target Roads in Study Area (Western Area)



Source: The Study Team

Figure 2.2.70 Component of Pavement Types for Target Roads in Study Area

The estimated pavement types in the Study Area are shown in Figure 2.2.71, assuming that the pavement types for untargeted road is soil. The pavement types in the Study Area consists of 11.5% for AC, 0.5% for PCC, 0.1% for interlocking block, and 88.0% for soil. Nearly 90% of untargeted roads in the Study Area is soil.



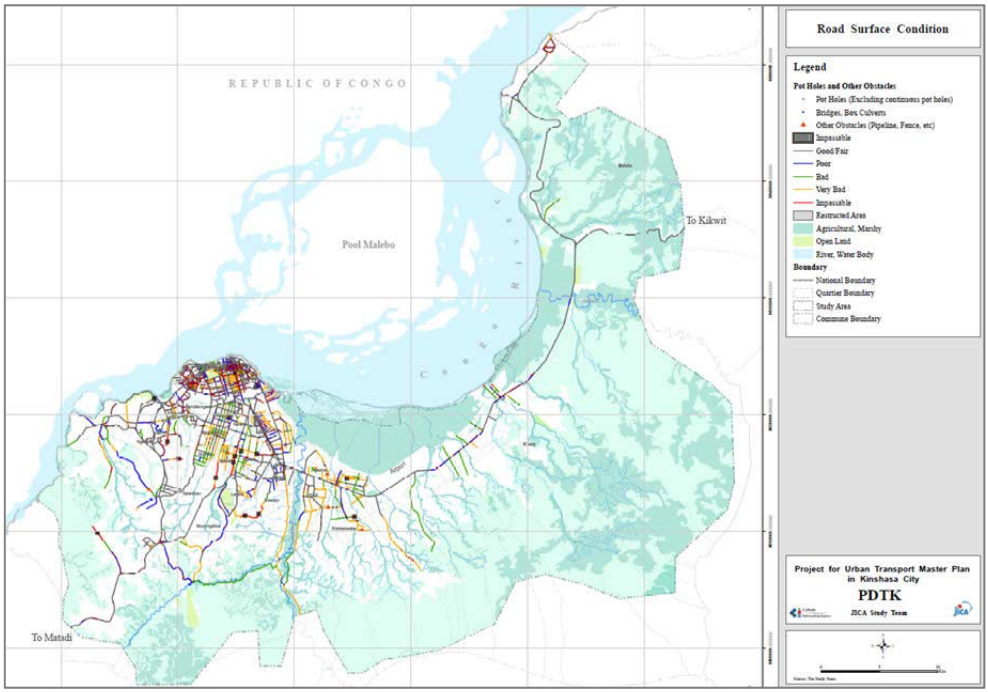
Source: The Study Team

Figure 2.2.71 Component of Pavement Types in Study Area

f) Road Surface Conditions

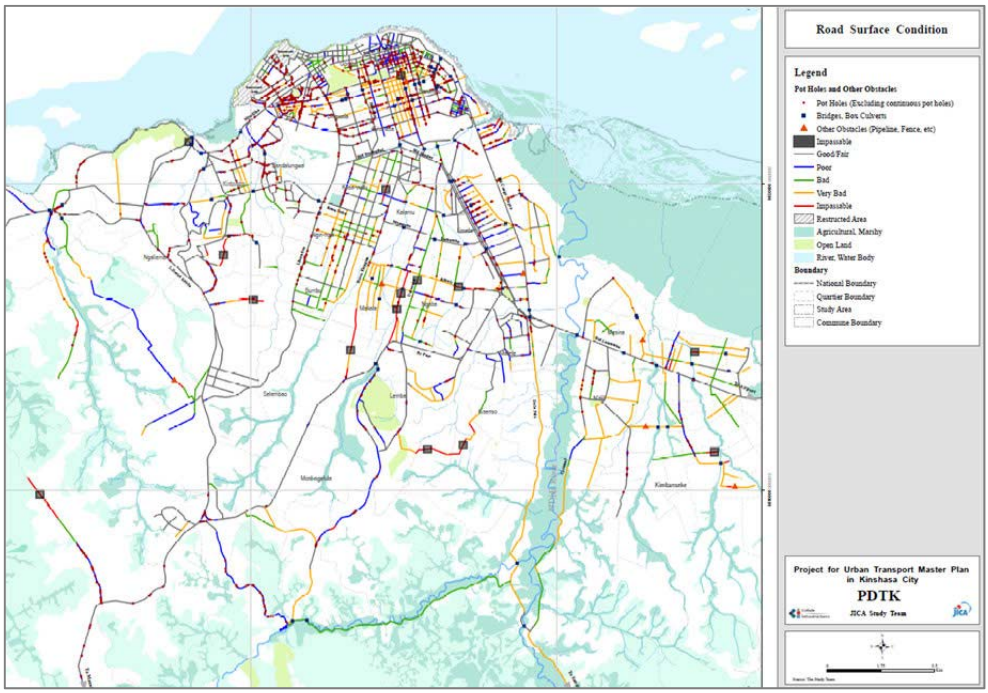
The current surface conditions for target roads in the Study Area are shown in Figure 2.2.72 and Figure 2.2.73. The surface conditions of trunk roads such as Lumumba Bld., Sendwe Bld., Triomphal Bld., 30 Juin Bld., L. Desire Kabila, By Pass, Liberation Ave. and etc. are basically in good or fair condition. However, the surface condition of the other roads is poor, or bad with numerous potholes.

The component of surface conditions for target roads in the Study Area is shown in Figure 2.2.74, and consists of 373.40 km of good or fair (47.0%), 134.43 km of poor (16.9%), 105.44 km of bad (13.3%), 163.38 km of very bad (20.6%) and 17.58 km (2.2%) as impassable. On more than half of the target roads, the surface conditions are poor or worse, and have hindered smooth traveling.



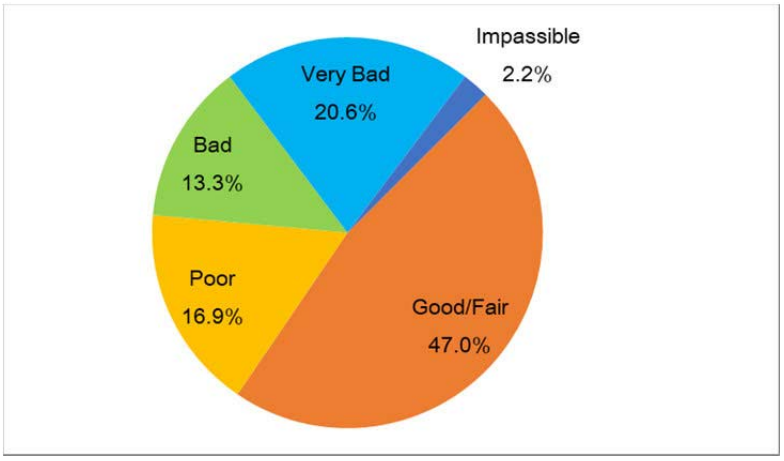
Source: The Study Team

Figure 2.2.72 Road Surface Conditions for Target Roads in Study Area (Whole Area)



Source: The Study Team

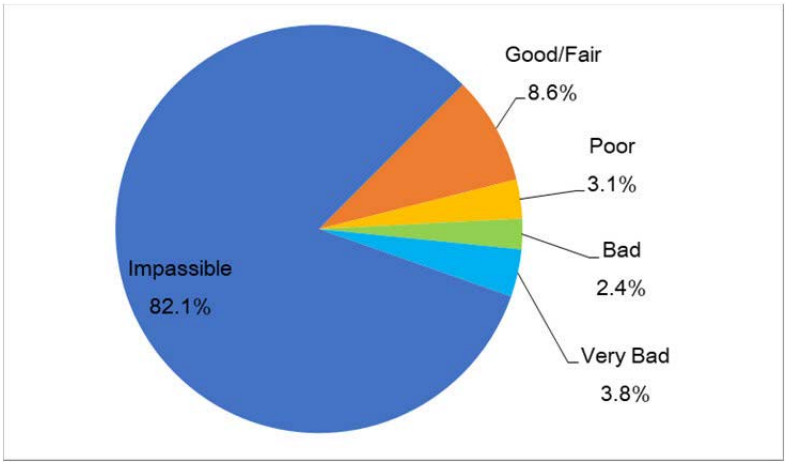
Figure 2.2.73 Road Surface Conditions for Target Roads in Study Area (Western Area)



Source: The Study Team

Figure 2.2.74 Component of Road Surface Conditions for Target Roads in Study Area

The estimated road surface conditions in the Study Area are shown in Figure 2.2.75, assuming that the surface conditions for untargeted road is impassable. The surface conditions in the Study Area are consists of 8.6% for good or fair, 3.1% for poor, 2.4% for bad, 3.8% for very bad and 82.1% for impassable.



Source: The Study Team

Figure 2.2.75 Component of Road Surface Conditions in Study Area

2.2.10 Logistics Survey (LS)

(1) Survey Method

The Logistics Survey consist of five surveys: 1) Traffic Count Survey of Truck and Freight Vehicle (TFS), 2) Truck OD Interview Survey with Drivers (TODS), 3) Interview Survey with Cargo Owners and Logistics Companies (ISC), 4) Passenger Count Survey at Kinshasa Port (PCS) and 5) Passenger OD interview Survey at Kinshasa Port (PODI).

The TFS was conducted using digital video recorders. The vehicles are counted by viewing the digital video record by vehicle type and direction, at intervals of fifteen minutes. The vehicle classification for the TFS is as follows:

Type 1:	Pick-up (Single/ Double Cab)	Type 7:	20 ft Container
Type 2:	Light Truck (2 axle)	Type 8:	2×20 ft Containers
Type 3:	Heavy Truck (3 axles)	Type 9:	40 ft Container
Type 4:	Heavy Truck (More than 3 axles)	Type 10:	45 ft Container
Type 5:	Empty 20 ft flat bed	Type 11:	Other Truck and Freight Vehicles
Type 6:	Empty 40 ft flat bed		

The TODS was conducted at the same survey station as the TFS. The surveyors stopped vehicles with cooperation of police officers to minimize disturbance to traffic flow as well as to secure traffic safety. The interview vehicles were selected randomly to exceed a sampling rate of 10% by vehicle types and direction by hourly traffic volume; surveyors recorded the vehicle type, number of passengers, address of origin/destination, trip purpose, commodity type, and loading ratio.

The ISC was conducted through the interview method. The surveyors visited and interviewed for company profile (number of employees, area of factory, floor area, main product, number of freight vehicles), major origin or destination, modal share in the logistics, reason for modal choice, logistics cost, and travel time.

The PCS was conducted at Ngobila Beach. The surveyors continuously counted the number of passengers and record the information on the survey sheets.

The PODI was conducted at departing passenger gates at Ngobila Beach. The sample passengers are selected randomly to exceed a sampling rate of 10% of all departing passengers, and surveyors interviewed for nationality, address of origin and/or land mark, origin type, trip purpose, access mode of transport, cost of transportation, and travel time.

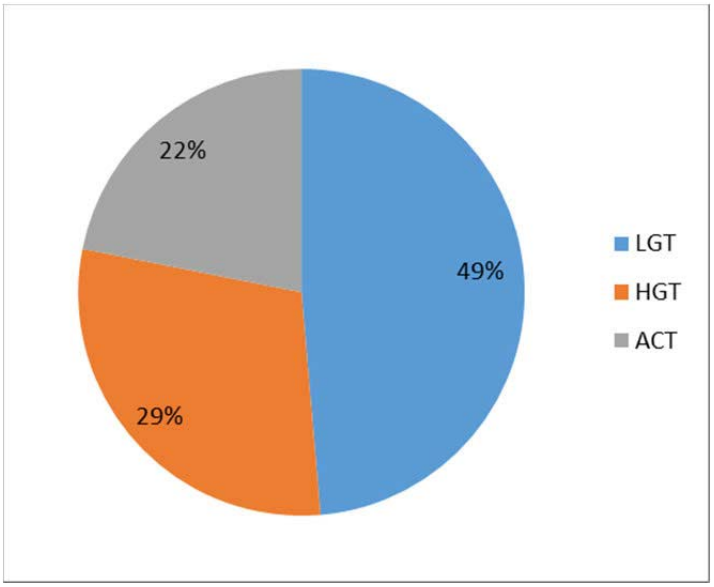
(2) Survey Location and Duration

To understand major freight movement and information, The TFS and TODI were conducted at totally 74 gates at SCTP Port, private ports, logistic center, industrial area and factories. The PCS and PODI was conducted at Ngobila Beach to understand ship passenger movements to/from the Study Area. The ISC was conducted with 40 companies considering company scale, location and product.

(3) Basic Analysis and Major Findings

a) Freight Vehicles

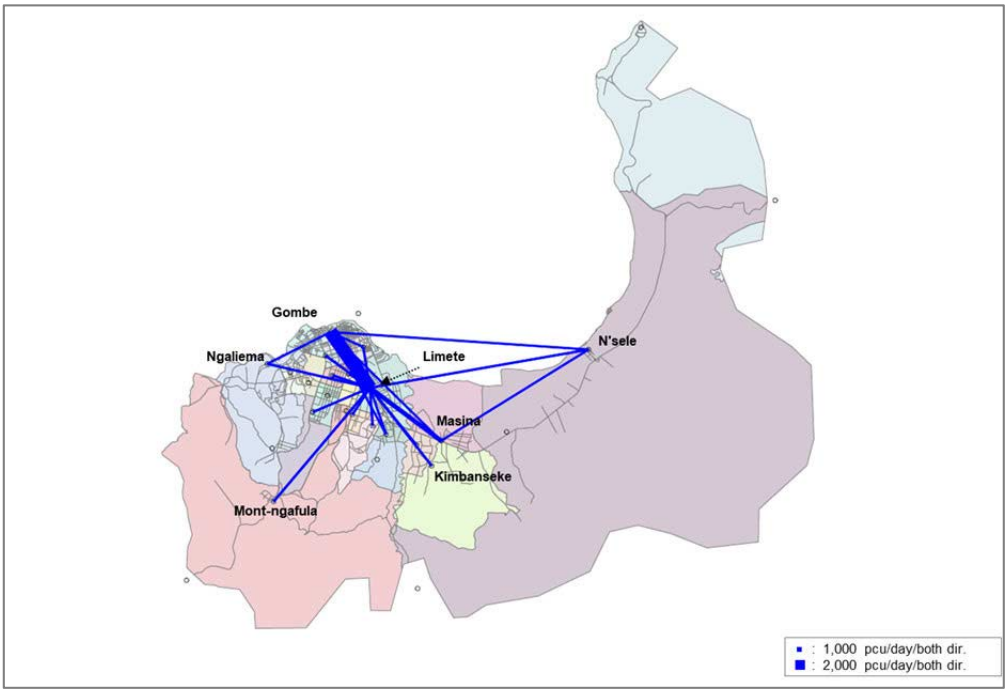
The total number of daily freight vehicles was 24,000 vehicles at 74 survey locations, and the composition of freight vehicles is shown in Figure 2.2.76. Among these freight vehicles, about half of the freight vehicles is LGT (Light Goods Truck), followed by HGT (Heavy Goods Truck) at 29%.



Source: The Study Team

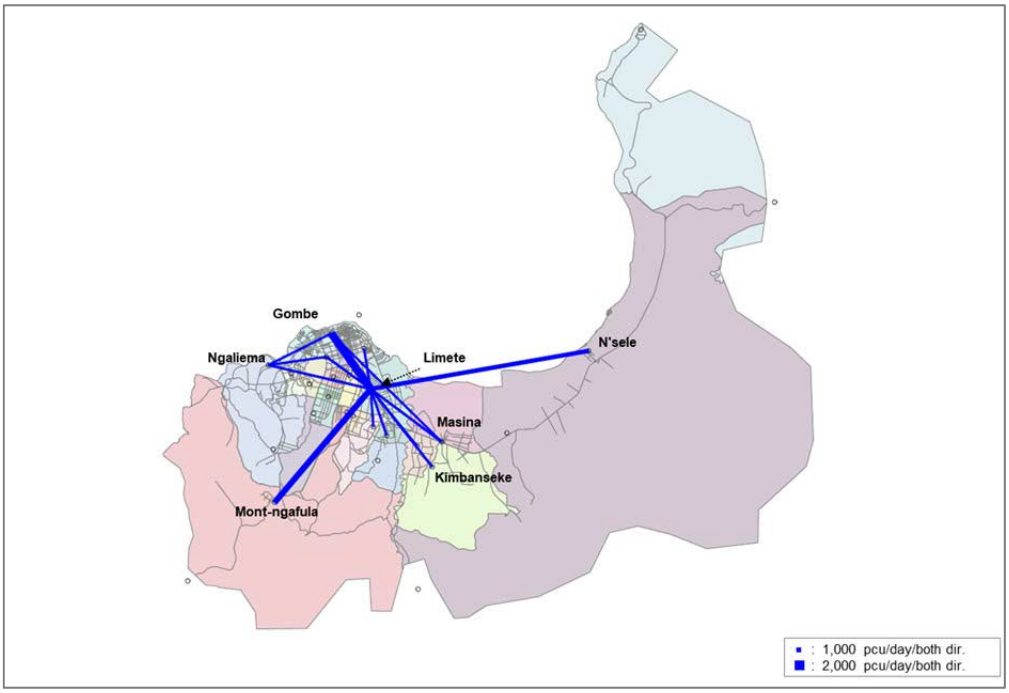
Figure 2.2.76 Composition of Freight Vehicles (all survey location)

Figure 2.2.77, Figure 2.2.78, and Figure 2.2.79 show major origins and destinations of LGT, HGT, and ACT in the Study Area. It indicates that freight vehicles (LGT, HGT, ACT) are concentrated in Limete Commune, followed by the Gombe, Masina and Mont-ngafula communes.



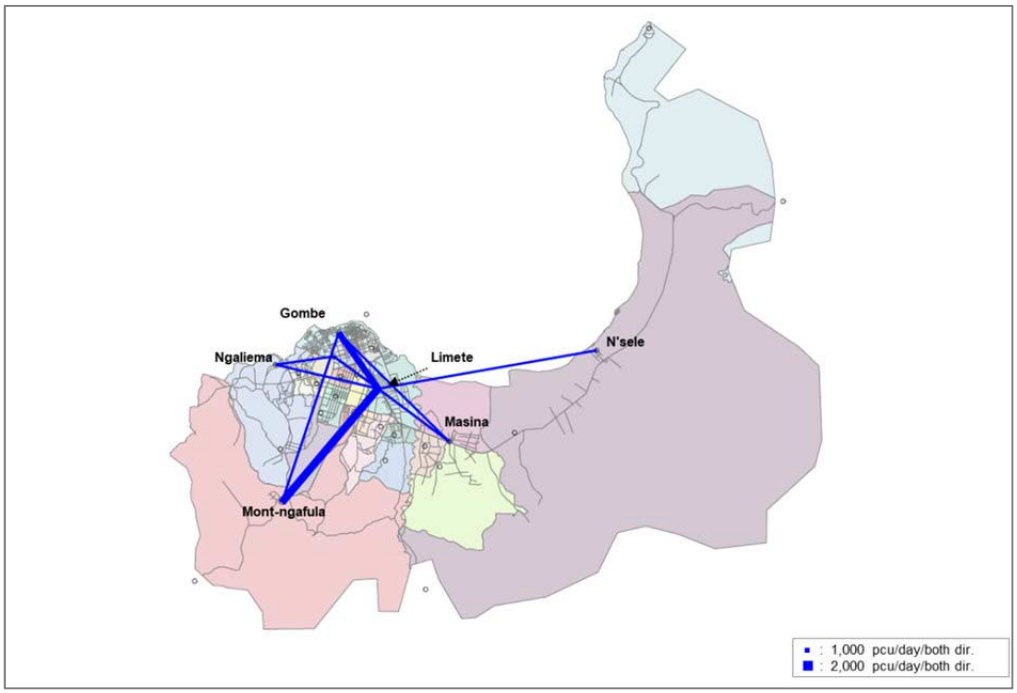
Source: The Study Team

Figure 2.2.77 Major Origin and Destination of LGT



Source: The Study Team

Figure 2.2.78 Major Origin and Destination of HGT

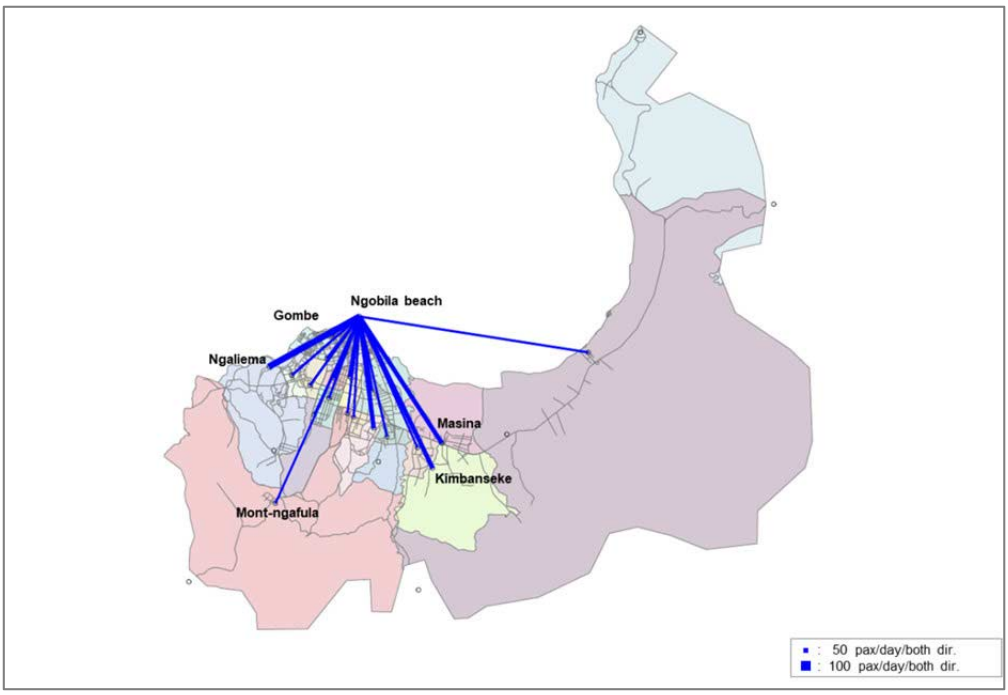


Source: The Study Team

Figure 2.2.79 Major Origin and Destination of ACT

b) Passenger Demand at Ngobila Beach

The daily ship passengers to/from Ngabila Beach and Brazzaville were 400 passengers on the survey date. Figure 2.2.80 shows major origin of ship passengers; it indicates that passenger trips are largely distributed in Kinshasa Gombe, Ngaliema, Kimbanseke. Masina Commune has the largest share, followed by the Kimbanseke and N'sele communes. On the other hand, freight vehicles are distributed among the Masina, Kimbanseke, Limete communes.



Source: The Study Team

Figure 2.2.80 Major Origin of ship passengers at Ngobila Beach

2.2.11 Building Use Survey (BUS)

(1) Survey Method

The building use survey consists of two surveys: 1) digitalization of the footprint and 2) field survey for number of floors and building use.

The digitalization of the footprint was carried out based on a satellite image (Pléiades) with a resolution of 50cm taken from 2014 to 2017. The work was done from 19th April until 8th May, 2017. The approximate number of footprints was of 80,000 buildings.

After digitalization of the footprint, the footprint data was uploaded to ArcGIS Online, and the number of floors and building use were surveyed in the field using a smartphone device. The survey was carried out from 9th May until 29th June, 2017. The classification of building use is as shown in Table 2.2.20.

Table 2.2.20 List of Building Use

Category	Code	Code Name	Description
Mixed-Use	11	Mixed-use R & C	Mixed-use Residence and Commercial
	12	Mixed-use R & M	Mixed-use Residence and Manufacturing
	13	Mixed-use R & O	Mixed-use Residence and Other
	14	Mixed-use O & O	Mixed-use Other and Other
Residential	21	Exclusive Private House	Independent House (Habitat residential haut standing)
	22	Individual Private House	Independent building for residential for individual
	23	Apartment	Apartment house, Condominium, Townhouse
	24	Low Income Houses	Barracks, Temporary House (Habitat en auto-construction)
Commercial	31	Large Shop	Shopping centre, Super market
	32	Small Shop	Small shop
	33	Restaurant	Restaurant, Café
	34	Hotel	Hotel, Motel, Service apartment
	35	Open Space Commercial Activity	Portable Shop, Food Stall, Street Stall
	36	Other Commercial	Theatre, Filling station
Business	41	Business	Office, Bank, Post office, Telecommunication
Government	51	Government	Government office, Court, Police, Fire station,
	52	Defence	Gendarmerie, Military facilities
Education	61	Education	University, College, High school, Junior high school
	62	Other Education	Library, Museums, Public hall
Health	71	Hospital	Hospital, Dispensary
Transport	81	Transport Facility	Station, Bus terminal, Airport, Ferry landing
Industries	91	Manufacturing	Small factory such as garage, food factory, carpentry shop
	92	Warehouse	Warehouse, Market
Other	101	Utility	Electricity, Water, Telecommunication, Garbage Disposal
	102	Religious facility	Church, Temple, Mosque
	103	Under construction	Under construction
	104	Other	Other

Source: The Study Team

(2) Survey Coverage

The target area of this survey is six Communes: Bandalungwa, Barumbu, Gombe, Kinshasa, Kintambo, and Lingwala.

(3) Basic Analysis and Major Findings

The followings are major findings from the results[2] of the BUS. The numbers of floors, floor area by building use are shown in Table 2.2.21 and Figure 2.2.81.

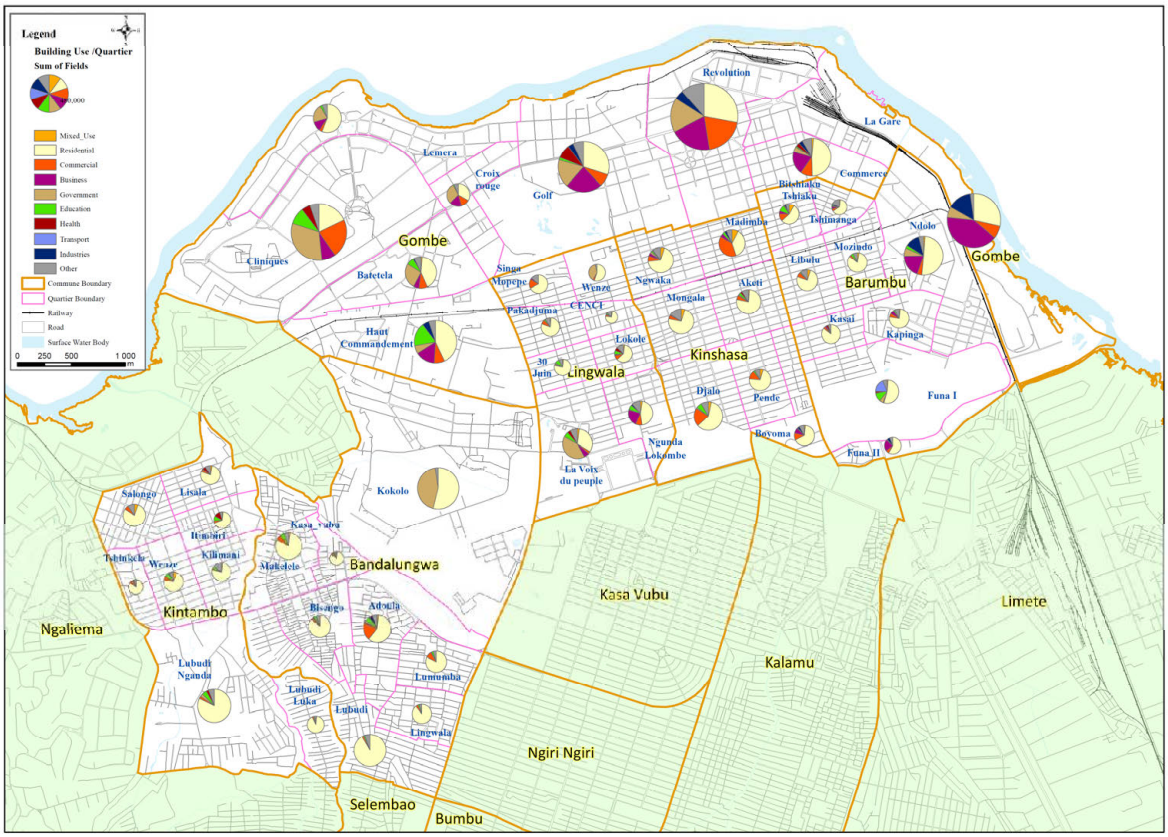
- In the six communes, high- and middle-rise buildings (more than 3 stories) are concentrated only in Gombe Commune, and other communes are almost occupied by low-rise buildings.
- The urban building use, 57.2% (732,778 m^2 out of 1,280,965 m^2) of commercial use, 79.8% (1,121,746 m^2 out of 1,405,408 m^2) of business use, and 65.6% (957,528 m^2 out of 1,459,808 m^2) of government, is concentrated in Gombe Commune.
- On the other hand, residential use is spread outside of Gombe Commune. Composition of residential use in Gombe Commune is only 32.1% (1,843,651m^2 out of 5,744,969 m^2) but residential use of other five Communes ranges from 50% to 80%). It is assumed that outside of the six communes, there is more residential use.

[2] The building use of "mixed-use" was not considered.

Table 2.2.21 Summary of Floor Area by Building Use by Quartier

	Mixed-Use	Residential	Commercial	Business	Government	Education	Health	Transport	Industries	Other	Total
Bandalungwa	**17,172**	**1,462,508**	**107,220**	**13,050**	**249,404**	**47,273**	**13,505**	**1,179**	**8,737**	**89,933**	**2,009,981**
Adoula	3,713	161,077	54,476	4,249	5,314	14,389	3,954	290	8,130	15,366	270,957
Bisengo	3,403	152,216	6,258	2,376	999	6,206	2,462	369	139	8,204	182,633
Kasa_vubu	1,274	66,111	3,577	674	456	1,831	1,748	0	0	4,799	80,469
Kokolo	0	297,290	1,063	882	240,708	0	0	0	0	12,991	552,933
Lingwala	42	131,479	5,346	574	808	3,582	286	0	0	6,404	148,521
Lubudi	2,798	317,275	5,356	1,126	0	4,555	2,167	0	0	19,477	352,755
Lumumba	943	133,843	14,915	1,702	766	4,588	1,174	492	230	7,670	166,325
Makelele	4,998	203,217	16,229	1,468	351	12,123	1,714	28	237	15,023	255,388
Barumbu	**38,641**	**1,034,402**	**81,845**	**147,956**	**46,892**	**68,558**	**16,593**	**36,343**	**73,192**	**113,620**	**1,658,042**
Bitshiaku Tshiaku	12,114	84,294	18,311	6,953	865	16,335	2,226	0	2,814	8,965	152,877
Funa I	2,797	103,993	2,114	1,938	10,756	23,559	3,763	36,314	1,557	12,758	199,551
Funa II	194	65,511	7,029	24,542	432	0	1,724	0	5,995	7,353	112,780
Kapinga	2,601	111,738	9,112	8,892	124	3,781	892	0	96	11,532	148,766
Kasai	133	116,265	4,340	4,049	288	986	3,878	28	336	7,361	137,665
Libulu	8,424	123,079	11,525	1,278	345	2,906	893	0	783	17,650	166,883
Mozindo	4,543	121,965	4,918	250	628	5,725	1,109	0	0	10,563	149,701
Ndolo	6,132	247,018	19,925	96,146	32,434	13,098	1,932	0	58,643	19,821	495,149
Tshimanga	1,701	60,539	4,571	3,908	1,020	2,169	176	0	2,968	17,618	94,670
Gombe	**32,352**	**1,843,651**	**732,778**	**1,121,746**	**957,528**	**251,860**	**146,645**	**2,703**	**262,867**	**392,838**	**5,744,969**
Batetela	4,380	141,796	29,005	19,493	89,432	25,928	2,127	476	4,173	23,941	340,752
Cliniques	2,139	165,884	203,280	73,696	290,032	90,046	46,329	0	2,570	49,054	923,031
Commerce	6,482	230,317	48,043	94,159	21,013	5,094	15,993	420	15,616	40,404	477,542
Croix rouge	572	63,897	24,015	32,718	56,816	3,087	1,303	614	1,398	12,012	196,431
Golf	2,334	238,786	64,909	184,720	143,034	12,354	69,649	560	27,273	55,051	798,670
Haut Commandement	368	247,392	45,431	87,421	34,246	102,777	1,412	0	28,708	29,936	577,690
La Gare	3,277	244,133	63,639	348,342	55,741	2,194	5,056	0	125,789	19,051	867,223
Lemera	0	158,393	9,514	29,717	58,581	6,907	0	141	369	17,731	281,353
Revolution	12,800	353,053	244,941	251,479	208,632	3,473	4,776	492	56,972	145,660	1,282,278
Kinshasa	**64,257**	**982,065**	**232,597**	**38,299**	**16,135**	**44,029**	**15,047**	**332**	**15,338**	**150,676**	**1,558,776**
Aketi	2,932	168,115	12,630	486	3,132	7,138	4,965	0	243	20,246	219,888
Boyoma	2,437	103,395	17,906	12,789	1,683	0	995	0	5,453	13,254	157,911
Djalo	9,007	170,386	59,752	2,358	3,380	18,018	2,348	203	461	23,733	289,647
Madimba	18,692	91,633	94,077	9,700	159	8,021	986	0	6,328	17,549	247,146
Mongala	11,267	166,955	9,965	2,415	471	2,274	1,789	67	933	37,290	233,426
Ngwaka	11,670	159,523	16,783	8,811	5,652	4,277	2,483	62	936	24,677	234,875
Pende	8,251	122,059	21,485	1,740	1,658	4,301	1,480	0	983	13,926	175,882
Kintambo	**32,576**	**1,035,981**	**51,610**	**6,487**	**14,711**	**50,211**	**35,577**	**453**	**1,682**	**96,245**	**1,325,533**
Itimbiri	1,583	79,774	4,758	50	125	11,181	14,125	0	0	5,662	117,259
Kilimani	2,491	105,713	3,547	401	1,324	5,871	608	0	250	20,461	140,665
Lisala	4,368	112,898	5,484	1,576	0	401	7,302	139	34	13,242	145,444
Lubudi Luka	1,589	106,311	3,253	135	0	1,836	794	0	0	3,204	117,122
Lubudi Nganda	2,586	302,366	7,820	1,755	10,041	18,046	8,565	315	1,100	20,531	373,124
Salongo	10,158	148,917	10,523	1,080	131	807	1,856	0	0	18,303	191,776
Tshinkela	2,030	73,119	6,180	349	1,820	1,409	683	0	114	4,185	89,890
Wenze	7,772	106,882	10,044	1,140	1,270	10,658	1,644	0	184	10,658	150,253
Lingwala	**21,224**	**666,462**	**74,916**	**77,870**	**175,137**	**55,841**	**22,004**	**1,542**	**4,979**	**119,234**	**1,219,207**
30 Juin	2,172	87,564	1,833	1,602	2,595	9,612	234	0	0	8,871	114,482
CENCI	1,262	50,450	2,874	1,276	76	2,210	38	427	8	8,863	67,485
La Voix du peuple	6,581	98,738	7,566	18,274	126,597	17,577	10,868	373	704	24,958	312,235
Lokole	2,717	74,643	10,388	2,828	316	8,595	7,712	0	0	16,142	123,341
Ngunda Lokombe	5,259	98,724	18,281	49,495	2,198	13,082	1,514	671	4,267	25,408	218,898
Pakadjuma	1,382	106,864	10,192	338	348	3,244	337	0	0	12,606	135,312
Singa Mopepe	867	88,383	20,337	3,371	537	1,106	699	0	0	18,468	133,768
Wenze	984	61,096	3,445	685	42,470	415	602	71	0	3,917	113,685
Total	**206,221**	**7,025,069**	**1,280,965**	**1,405,408**	**1,459,808**	**517,773**	**249,371**	**42,552**	**366,795**	**962,547**	**13,516,508**

Source: The Study Team



Source: The Study Team

Figure 2.2.81 Summary of Floor Area by Building Use by Quartier

2.2.12 Bus Route Survey (BRS)

(1) Survey Method

The BRS consists of 3 surveys: 1) Bus Hearing Survey, 2) On-Board Bus Survey and 3) Bus Frequency and Occupancy Survey.

The BHS was conducted to understand the current status of operations, management, and financing of the public transport operators, owners, and drivers. The surveyors interviewed about the current status of the public transport operators, owners, and drivers. The target interviewees are ACCO (*Association des Propriétaires de Véhicules Affectés au Transport en Commun* / Association of Public Transport Vehicles Owners) for the drivers of taxis (Ketch) and APVCO (*Association des Chauffeurs du Congo* / Association of Congo Drivers) for the drivers of Esprit de Vie.

The OBBS was designed to understand the current status of operation and utilization of a taxi, taxibus and bus on arterial corridors with the potential of introducing BRT (Bus Rapid Transit) in the future. The surveyors were dispatched to board a sampled bus for each target corridor continuously from 6:00 am to 10:00 pm, in order to acquire a series of information about its

operation and passengers. GPS loggers were carried by the surveyors to grasp a precise route alignment of the bus.

The BFOS was conducted to grasp bus frequency and occupancy rate by bus type on each target corridor. The surveyors counted the number of buses and their occupancy rate, at intervals of 15 minutes continuously from 6:00 am to 10:00 pm.

(2) Survey Location

The field surveys were conducted on the 7 corridors shown in Figure 2.2.82. Each of specific targets for BHS, OBBS and BFOS are described as follows.

1) Bus Hearing Survey (BHS)

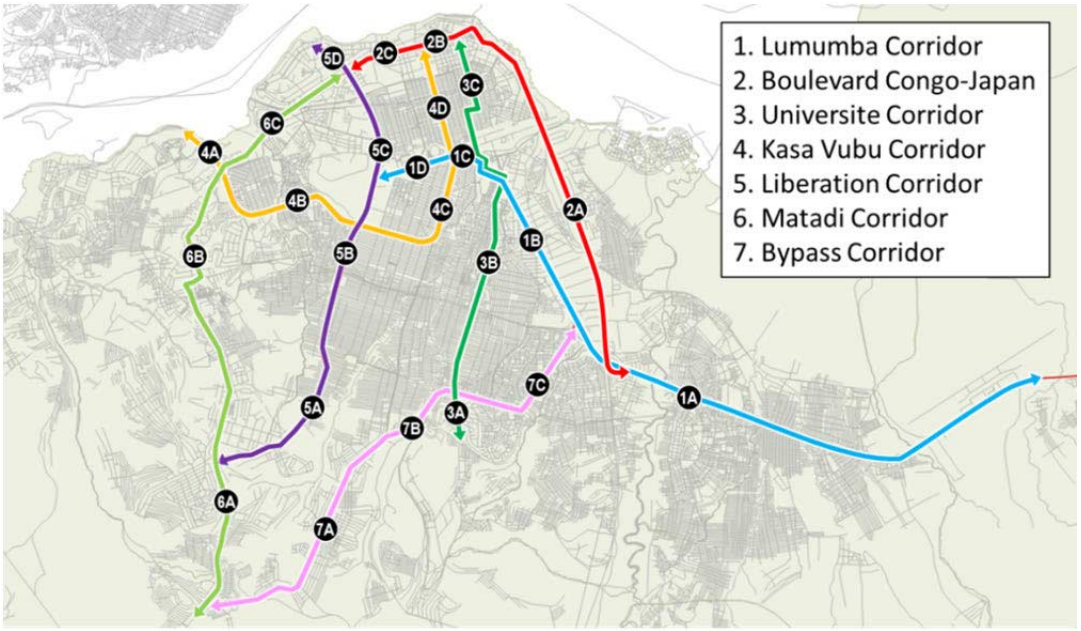
- No. of associations: 2 associations (APVCO, ACCO)
- No. of owners: 12 owners (2 owners * 3 categories * 2 associations)
- No. of drivers: 8 drivers (4 drivers * 7 corridors)

2) On-Board Bus Survey (OBBS)

- Number of corridors: 7 corridors
- Number of samples: 5 sample buses in each corridor

3) Bus Frequency and Occupancy Survey (BFOS)

- Number of corridors: 7 corridors
- Number of locations: 24 locations in total



Source: The Study Team

Figure 2.2.82 Survey Location and Target Corridors of Bus Route Survey (BRS)

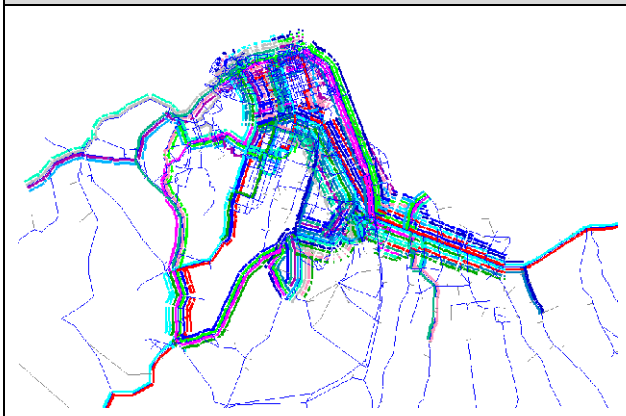
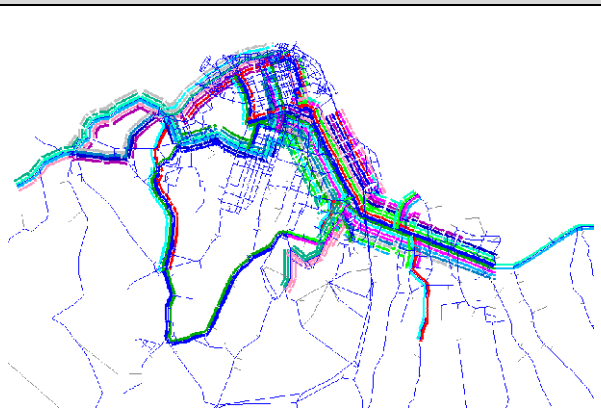
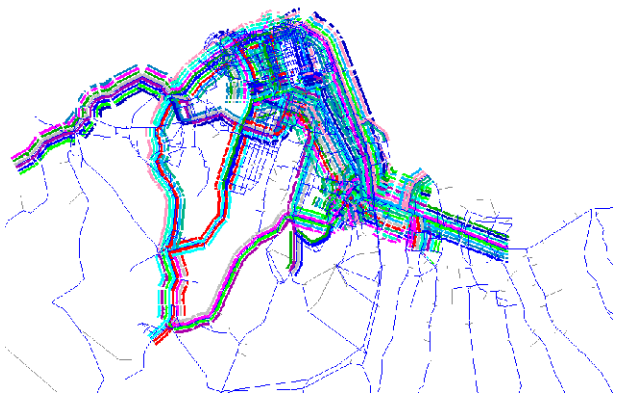
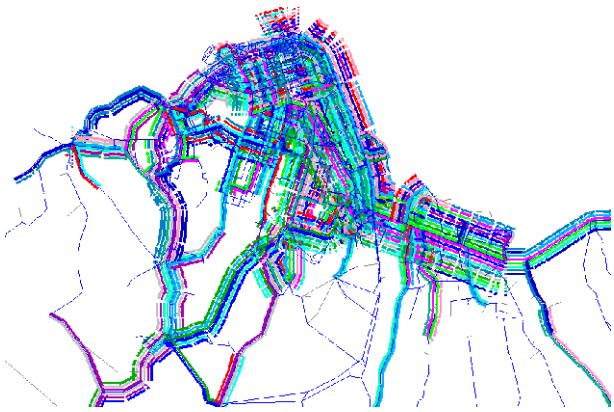
(3) Basic Analysis and Major Findings

The result of the OBBS is summarized in Table 2.2.22. Based on the result of the OBBS, the transport network data of each operator was prepared for transport modelling as shown in Figure 2.2.83.

Table 2.2.22 Summary of On-Board Bus Survey Result

Corridor	Bus Type	Bus Size	Origin and Destination		No. of Roundtrip	Distance (km)	Travel Time (min) Min / max	Max Pax.
			Suburban Area	Inner-City Area				
1	TRANSCO	L	Kingasani	Fonction Publique	6	21.6	17 / 76	110
	New Transkin	M	Kingasani	Zando	6	17.9	19 / 78	50
	Esprit de Vie	M	N'djili	Zando	7	15.5	17 / 81	51
	Taxi-bus(1)	S	Kingasani	ISC	7	19.2	44 / 80	27
	Taxi-bus(2)	S	Kingasani	Gombe	7	19.2	42 / 67	32
2	TRANSCO	L	Petro Congo	Zando	5.5	15.7	17 / 56	71
	Esprit de Vie	M	Petro Congo	Zando	6	15.7	19 / 60	30
	Taxi-bus(1)	S	Petro Congo	Zando	3.5	15.7	35 / 76	26
			Petro Congo	Zando	0.5	15.7	26	20
			Petro Congo	Kingabwa	2.0	-	19 / 92	24
			Matete	Zando	0.5	11.2	35	20
			Matete	Victoire	0.5	8.4	9	12
	Taxi-bus(2)	S	Petro Congo	Zando	4	15.7	37 / 73	19
3	TRANSCO	L	Campus	Gare Centrale	5	17.8	45 / 87	93
	New Transkin	M	Campus	Victoire	6.5	15.2	19 / 49	48
			Righini	Victoire	1	12.4	41 / 49	36
	Taxi-bus	S	Campus	Zando	4.5	14.7	41 / 92	25
4	TRANSCO(1)	L	Mbudi	Gambela	5	16.2	51 / 118	61
			Mbudi	Bandal	0.5	12.6	58	14
	TRANSCO(2)	L	Mbudi	Maman Yemo	5	15.6	35 / 66	103
	Esprit de Vie	M	Mbudi	Gambela	5	16.2	25 / 61	31
	Taxi-bus(1)	S	Pompage	Bongolo	4.5	15.0	35 / 65	29
			Mbudi	Bongolo	1	16.8	55 / 56	19
			Pompage	Bongolo	2	15.0	49 / 56	38
	Taxi-bus(2)	S	Pompage	Gambela	1.5	14.3	57 / 79	18
			Mbudi, Ponpage	Gambela	3.5	16.2	38 / 128	29
5	Esprit de Vie	M	Selembao	Zando	5.5	9.9	24 / 48	31
	Taxi-bus(1)	S	Ngiri Nrgi	Gare Centrale	7	7.4	22 / 41	29
	Taxi-bus(2)	S	Matadi Kibala	ISP	4.5	17.5	40 / 108	26
	Taxi-bus(3)	S	Matadi Kibala	ISP	3.5	17.5	45 / 75	26
6	TRANSCO	L	UPN	Gare Centrale	5	17.0	44 / 85	85
7	TRANSCO	L	UPN	Matete	5.5	18.7	47 / 76	106
	Esprit de Vie	M	UPN	Kingasani	4	13.4	32 / 62	32
	Taxi-bus(1)	S	UPN	Clinique/UniKin	6	14.6	23 / 35	34
	Taxi-bus(2)	S	Citi Verte	Pascal	6	20.3	44 / 70	22

Source: The Study Team

TRANSCO	New Transkin
	
APVCO	**ACCO**
	

Source: The Study Team

Figure 2.2.83 Location of Target Corridors

The result of the BFOS is summarized in Table 2.2.23, which was utilized to prepare the estimation of current public transport frequencies for transport modelling.

It clearly shows that Lumumba Corridor is the most dominant corridor for public transport in the Study Area. It numerically describes the significant role of Boulevard Lumumba on sustaining a public transport network in the Study Area. In particular, almost 10,000 taxibuses per day per direction at survey location 1D are observed. This result indicates a high dependence of the residents on market-oriented public transport, rather than formal operators such as TRANSCO and NewTranskin.

Table 2.2.23 Summary of Bus Frequency and Occupancy Survey

Survey Location		No. of Daily Vehicles by Operator, Direction and Vehicle Type (vehicle/day)												Total
		TRANSCO				New Transkin				Esprit de Vie		Taxibus		
		Inbound		Outbound		Inbound		Outbound		In	Out	In	Out	
		Large Bus	Mini Bus	Large Bus	Mini Bus	Large Bus	Mini Bus	Large Bus	Mini Bus	Mini Bus	Mini Bus	Van	Van	
1	1A	824	67	642	16	67	224	76	46	539	182	10,291	9,272	22,246
	1B	566	39	289	93	0	5	38	298	230	364	7,951	7,501	17,374
	1C	310	54	332	73	9	6	9	125	268	156	5,640	3,971	10,953
	1D	214	62	165	49	0	47	0	0	322	283	2,111	2,105	5,358
2	2A	134	38	158	19	10	0	0	0	16	54	3,769	3,282	7,480
	2B	220	121	245	90	0	0	0	0	46	13	2,198	2,052	4,985
	2C	248	153	295	58	0	0	0	0	39	252	3,014	3,196	7,255
3	3A	244	12	302	9	5	3	44	0	5	0	785	712	2,121
	3B	0	47	0	0	0	11	0	0	16	11	2,750	2,388	5,223
	3C	143	101	0	0	133	0	0	0	238	0	3,239	0	3,854
4	4A	48	3	44	50	0	0	13	5	143	130	2,231	2,299	4,966
	4B	67	72	34	76	0	77	1	98	160	161	2,703	2,820	6,269
	4C	66	38	44	5	0	0	0	1	3	3	5,349	4,178	9,687
	4D	100	106	0	0	0	0	0	0	0	0	4,142	0	4,348
5	5A	0	0	0	0	0	0	0	0	0	0	1,606	1,521	3,127
	5B	0	0	0	0	0	0	0	0	66	46	4,736	4,998	9,846
	5C	160	148	118	133	0	0	0	0	0	119	3,921	3,799	8,398
	5D	165	90	125	37	0	0	0	0	136	126	625	677	1,981
6	6A	120	10	130	78	0	0	0	0	19	10	2,224	2,119	4,710
	6B	188	60	132	75	0	60	0	51	156	0	791	942	2,455
	6C	110	127	208	62	3	0	0	0	54	154	3,371	3,411	7,500
7	7A	132	15	126	7	1	0	2	0	28	31	2,308	2,422	5,072
	7B	133	12	68	0	0	0	0	0	41	0	2,775	2,917	5,946
	7C	208	13	240	15	0	144	0	258	136	190	2,091	1,921	5,216
Total		4,400	1,388	3,697	945	228	577	183	882	2,661	2,285	80,621	68,503	166,370

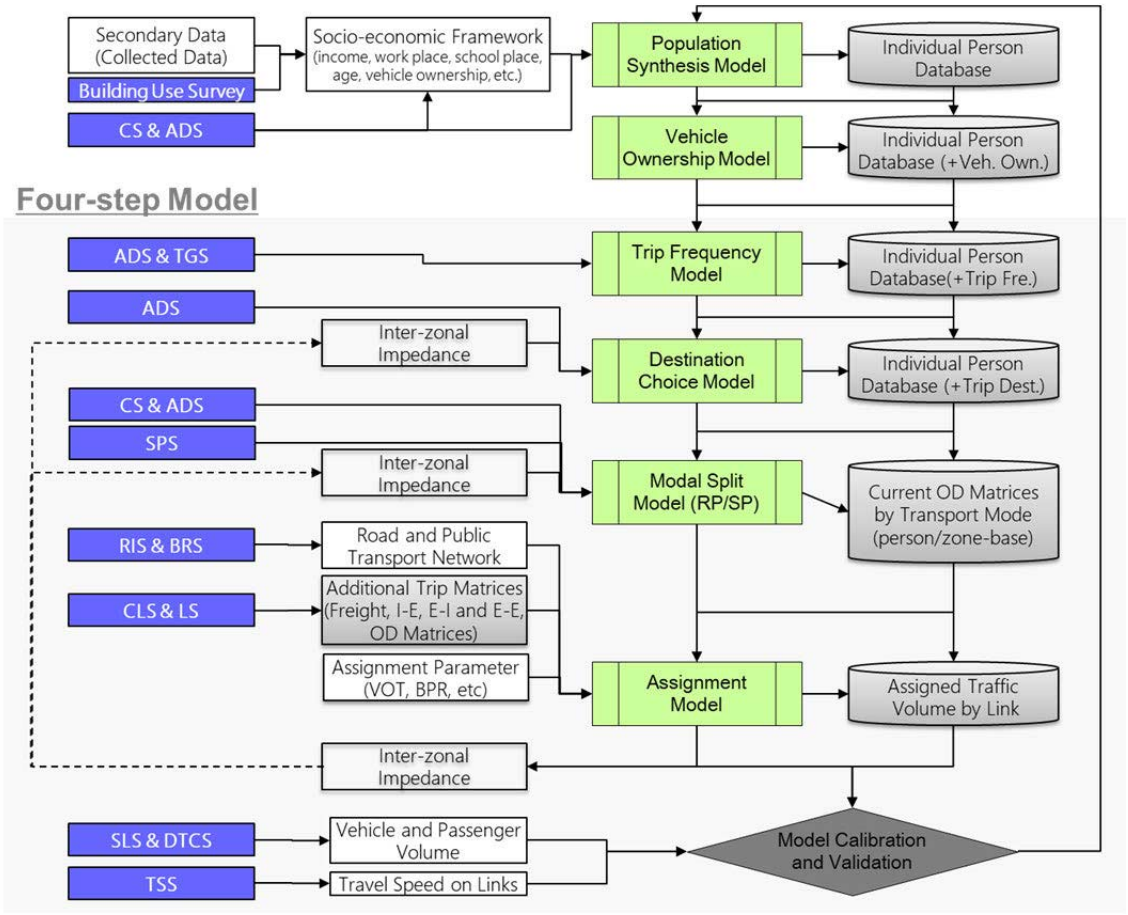
Source: The Study Team

2.3 Modelling for Transport Demand Projection

2.3.1 Modelling Approach

(1) Outline of Transport Demand Projection

As shown in Figure 2.3.1, the transport model for the Study includes three sub-models: 1) a Population Synthesis Model, 2) a Vehicle Ownership Model, and 3) a Conventional Four-Step Model with a disaggregated approach. Each model and its assumptions will be explained in the following sections.



Source: The Study Team

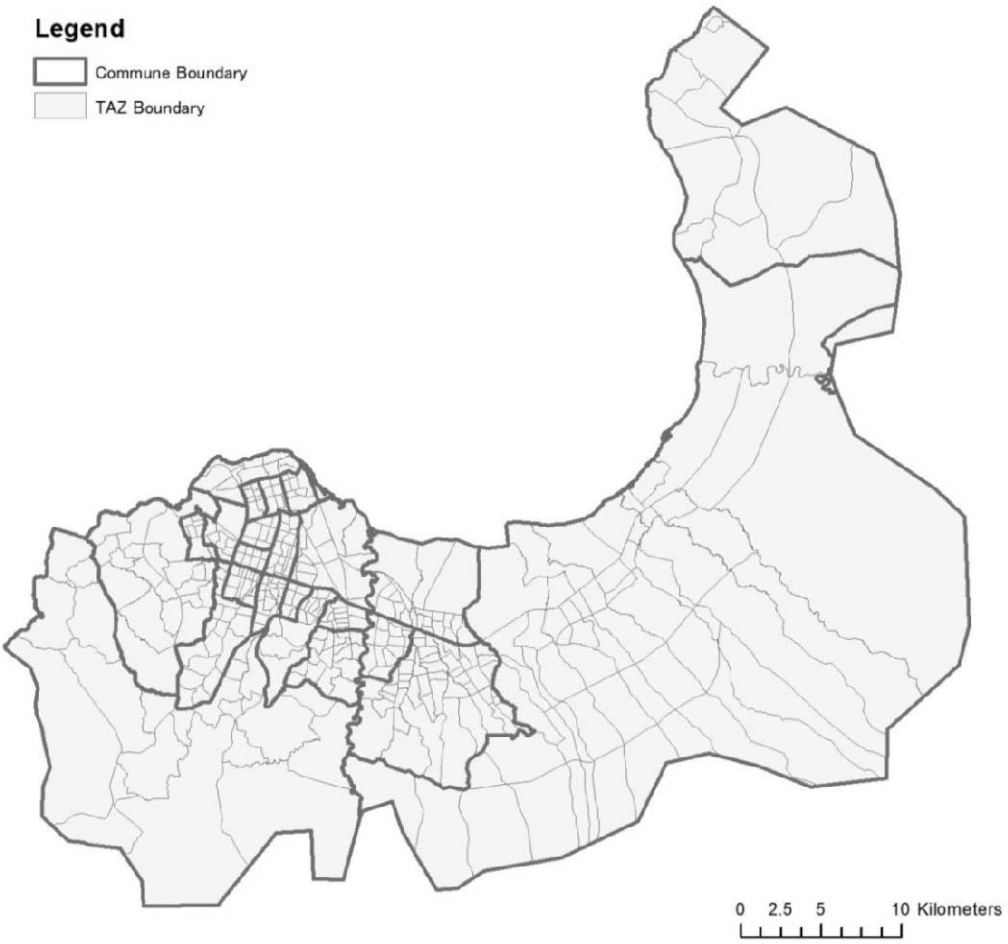
Figure 2.3.1 Flow of the Transport Model

Several software programs were used to prepare input data for the transport model, including PopGen, Biogeme, and ArcGIS. These data were then inputted to Cube Voyager software to develop the transport model. Cube Voyager software was selected due to the versatility in updating the transport model and the transparency of its calculation processes. The advantage of using this software is that it has been widely applied in more than 2,500 cities (70 countries) around the world and has many examples.

(2) Zoning System

The zoning system for the transport demand projection included 395 internal traffic analysis zones (TAZs) and six external and special generator TAZs. The internal TAZs were largely based on quartier boundaries from 2017, although several quartiers were divided into two or three TAZs due to comparatively large size of the quartier area, future development plans, and available socio-economic data. The six external and special generator TAZs incorporate three national and provincial roads, a port, the N'djili Airport and the Kinshasa-Brazzaville Bridge to capture significant future movement across the boundaries of the Study area.

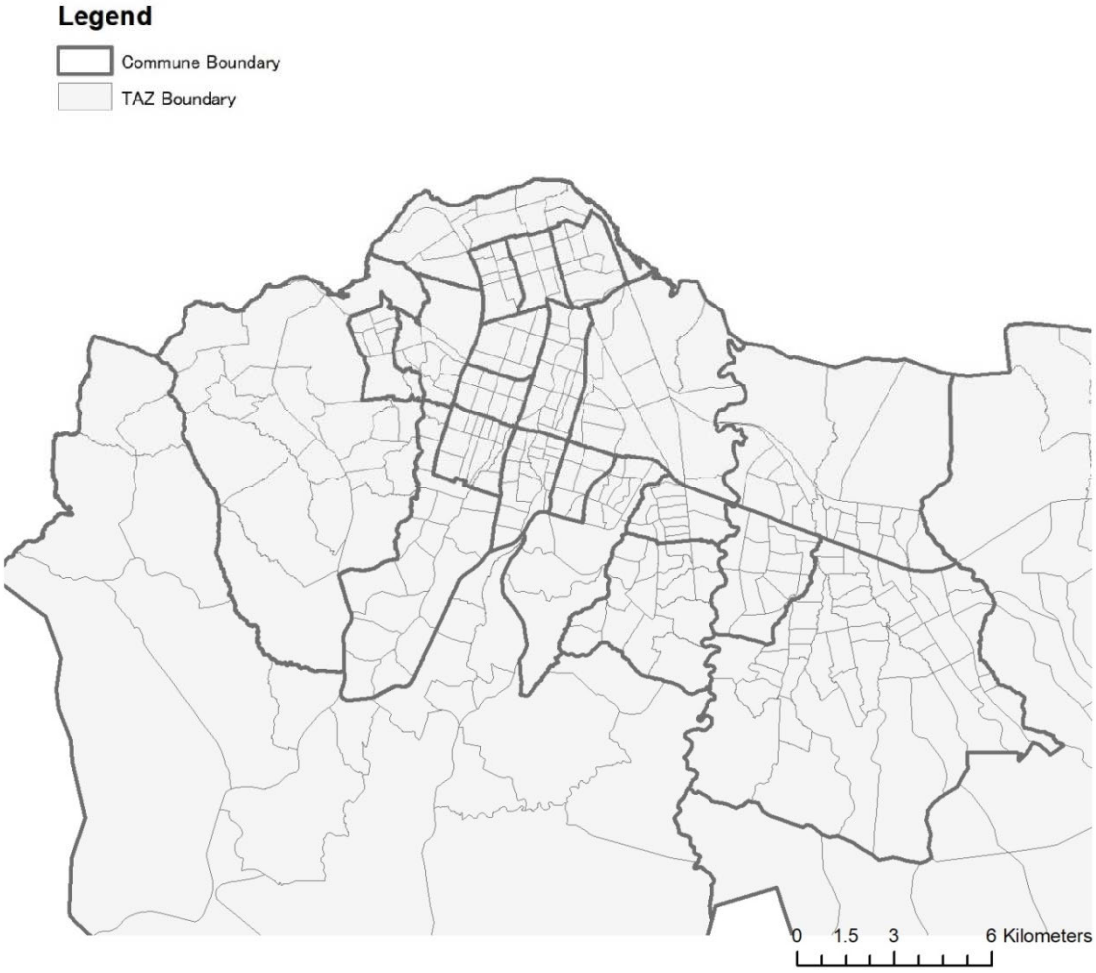
It is important that the zoning system and assignment network for the transport demand projection be consistent since the results of the transport demand projection could be inaccurate if the TAZs don't match the road network. The zoning system was designed to capture major movement within the Study area and the results of route assignment projections were verified with traffic count surveys through screen lines. The zoning system is summarized as shown in Table 2.3.1, Figure 2.3.2 and Figure 2.3.3.



Note: The quartier boundaries were defined through technical collaboration with the provincial Ministry of Interior

Source: The Study Team

Figure 2.3.2 Zoning System (The Study Area)



Source: The Study Team

Figure 2.3.3 Zoning System (Central Area)

Table 2.3.1 Summary of Zone System

Area Description		Number of TAZs
Internal TAZs	24 communes (365 quartiers)	395
External and Special Generator TAZs	National and provincial roads	3
	Port	1
	N'djili Airport	1
	Kinshasa-Brazzaville Bridge (future development)	1
Total		401

Source: The Study Team

2.3.2 Network Development in 2017

The key inputs for any transport model are on the supply side: the road and public transport network, and on the demand side: socio-economic data such as the total population, the working

population, and GRDP (Gross Regional Domestic Product). In this sub-section, the basic inputs in 2017 are presented on the supply side namely road network and transit. The key current and future socio-economic data inputs used for the transport demand projection are discussed in later chapters.

(1) Road Network

The road network for route assignment was developed based on the results of the Road Inventory Survey and includes all national, provincial, primary, secondary, and some of the tertiary roads in the Study Area. It is not necessary to cover all the roads in the Study Area, but it is crucial to verify consistency between the network density and zone system through the calibration processes of route assignment. For the model, the network includes the following key attributes for each road:

- Distance
- Road Class
- Road Condition
- Capacity
- Velocity

The distance, road class, and road conditions were identified using statistical data from OVD and results of a road inventory survey. The capacity setting was defined according to the Highway Capacity Manual 2010 and calculated using a peak hour factor (K value) and directional distribution (D value) of a screen line survey. Furthermore, side friction (pedestrian activities, hawkers etc.) plus the condition of the existing roads were used to adjust capacity and velocity. Consequently, the following capacity and velocity settings and adjustment factors by road condition were applied to the route assignment model as shown in Table 2.3.2 and Table 2.3.3 respectively.

Table 2.3.2 Capacity and Velocity Setting

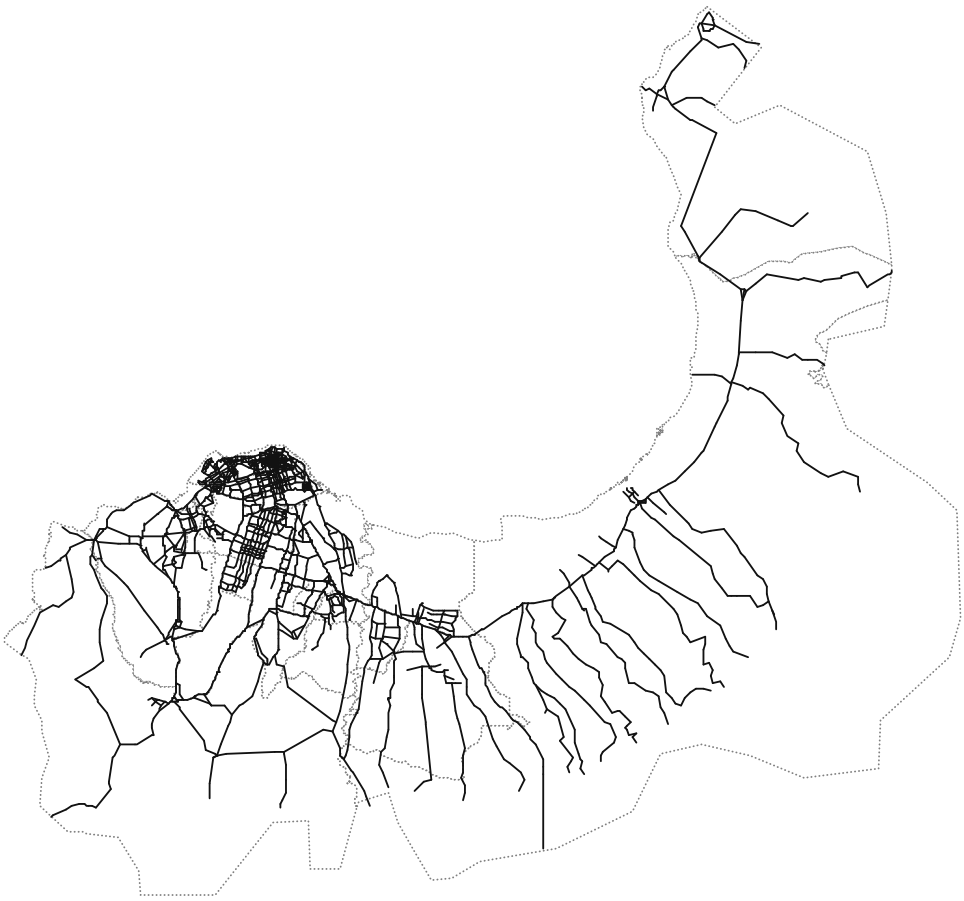
Road Class	Direction	Lanes	Capacity (PCU/day)	Velocity(km/h)
National, Provincial, Primary and Secondary Roads	Both	2	20,500	60
	Both	4	39,100	60
	Both	6	56,000	60
	Both	8	74,700	60
	Both	10	93,400	60
	One	1	10,300	50
	One	2	19,600	60
	One	3	28,000	60
	One	4	37,400	60
	One	5	46,700	60
Collector Roads (unpaved)	Both	1	7,000	40

Source: The Study Team

Table 2.3.3 Adjustment Factor by Road Condition

Road Condition	Capacity Adjustment Factor	Velocity (km/h)
Good	0.8	30
Fair/Good	0.5	20
Bad	0.4	10

Source: Road Inventory Survey, Screen Line Survey and Travel Speed Survey in 2017



Source: The Study Team

Figure 2.3.4 Road Network for Route Assignment

(2) Public Transport Network

The public transport network was developed based on a bus route survey, and operational data were collected from TRANSCO and New Transkin. Roughly 360 routes were considered, each of which includes the following key attributes:

- Route
- Frequency
- Fare
- Capacity
- Vehicle Size

2.3.3 Transport Modelling

(1) Population Synthesis

To estimate the disaggregated travel behaviour of each household and for each person in the Study Area, the attributes of the synthetic population generated must match those of the general population for each TAZ. As a population synthesizer, PopGen, software developed by Arizona State University and widely utilized for population synthesis in the United States and other countries, was used in the Study. It utilizes typical iterative proportional fitting (IPF) as a way for matching persons and households based on their control total by TAZ.

Considering the large amount of synthesized population in the Study Area, which is estimated to reach approximately 25 million in 2040, the population synthesis was conducted for 10% of the total population, assuming that each synthesized person represents 10 people. For household and person samples, the result of a Commuter Survey (CS) was utilized as it contains fundamental household and personal attributes which affect the estimation of travel behaviour.

Marginal control variables by household and personal attributes by each scenario in 2017, 2030 and 2040 as shown in Table 2.3.4 are estimated for each TAZ.

Table 2.3.4 List of Control Variables of Population Synthesis Models

Type	Attribute
Household	Household income class (12 categories)
Household	No. of household members (9 categories)
Person	Age group (8 categories)
Person	Social status (8 categories)

Source: The Study Team

(2) Vehicle Ownership Model (VOM)

The Vehicle Ownership Model (VOM) consists of two models: a Car Ownership Model and a Motorcycle Ownership Model as shown in Table 2.3.5.

The Car Ownership Model was designed to estimate the number of cars owned by each synthesized household unit based on their household, person and zonal attributes as listed in Table

2.3.5. This model was developed using the household database on the ADS and CS.

The Motorcycle Ownership Model aimed to estimate the number of motorcycles owned by each synthesized household unit based on their attributes as listed in Table 2.3.5. This model was developed using the household database on the ADS, CS and SPS which were weighted and integrated by the number of samples in each commune by household monthly income group. It should be noted that the motorcycle ownership estimation process targeted households in the middle-high monthly household income group (USD200/month and more) due to the limited number of household samples shown to own a motorcycle.

Table 2.3.5 List of Vehicle Ownership Models (VOM)

No.	Model
1	Car Ownership Model
2	Motorcycle Ownership Model

Source: The Study Team

Table 2.3.6 List of Variables for Vehicle Ownership Model

No.	Attribute	Variable
1	Household	Household monthly income
2		Household size
3	Person	Social status of head of household
4		Age of head of household
5	Zone	Population density in a household TAZ
6		Density of road surface area in a household TAZ

*: Standardized by the average monthly household income of USD 371.36 and its variance of USD 418.95.

Source: The Study Team

(3) Trip Frequency Model (TFM)

The Trip Frequency Model (TFM) consists of nine (9) models by trip purpose: Home to Work, Work to Home, Home to School, School to Home, Home to Shopping, Shopping to Home, Home to Other, Other to Home and Non-Home-Based purposes as shown in Table 2.3.7. Each of the models by trip purpose was designed to estimate the trip frequencies of each synthesized person per day based on their household, person, zone and trip attributes as listed in Table 2.3.8.

Table 2.3.7 List of Trip Frequency Models (TFM)

No.	Trip Purpose	Source
1	Home to Work	Commuter Survey (CS)
2	Work to Home	
3	Home to School	
4	School to Home	
5	Home to Shopping	Activity Diary Survey (ADS)
6	Shopping to Home	
7	Home to Other	
8	Other to Home	
9	Non-Home-Based	

Source: The Study Team

Table 2.3.8 List of Variables for Trip Frequency Model (TFM)

No.	Attribute	Variable
1	Household	Household monthly income
		Families with children: ・ Children: All age groups ・ Children: Less than 5 years old
		Household size
		Vehicle ownership (car / motorcycle)
2	Person	Social status
		Age
		Relationship to head of household
3	Zone	Population density in a household TAZ
4	Trip	Travel time(s) of trips

Source: The Study Team

(4) Destination Choice Model

The Destination Choice Model consists of two types of models: a Destination Zone Choice Model (DCM) and an Intra-Zonal Trip Choice Model (IZCM). The trip-based database from the Activity Diary Survey (ADS) was utilized for the development of this model.

Based on the TFM projections, the DCM was designed to estimate a series of choices about a destination zone for each trip by trip purpose as shown in Table 2.3.9. The definition of the destination zones was based on the statistical significance of the model, the socio-economic roles of each commune and on geographical locations along existing transport networks. The trip attraction estimates for each destination zone were adjusted by demographic indicators according to a socio-economic framework by zone as shown in Table 2.3.9.

In order to identify intra-zonal trips within destination zones for the DCM, the IZCM was developed to estimate whether each trip could originate within the same TAZ as shown in Table 2.3.11. If the IZCM estimated trips as being inter-zonal, their destinations by TAZ for each of the zones were randomly distributed based on the socio-economic framework of each scenario by TAZ in 2017, 2030 and 2040.

Table 2.3.9 List of Destination Zone Choice Models (DCM)

No.	Trip Purpose	Socio-economic Framework
1	Home-based Work	Working Population
2	Home-based School	Student Population
3	Home-based Shopping	Population, Working and Student Population
4	Home-based Other	Population
5	Non Home-based	Working Population

Source: The Study Team

Table 2.3.10 List of Intra-Zonal Trip Choice Model (IZCM)

No	Trip Purpose
1	Home-based Work trip
2	Home-based School trip
3/4/5	Home-based Other trip (HBSh, HBO, NHB)

Source: The Study Team

Table 2.3.11 List of Variables for Destination Zone Choice Model (DCM)

No.	Attribute	Variable
1	Zone	Population in a destination zone (persons/km^2) ・ Population density ・ University student population density ・ Working population density
		Transport accessibility in origin and destination zones ・ Ratio of formal public transport coverage (%) ・ Road surface coverage (ha)
		Area Size
2	Trip	Distance

Source: The Study Team

Table 2.3.12 List of Variables for Intra-Zonal Trip Choice Models (IZCM)

No.	Variable
1	Population and working population in origin TAZ (persons/km^2)
	Size of origin TAZ (ha)
2	Commune characteristics (dummy variable)

Source: The Study Team

(5) Modal Choice Model (MCM)

The Modal Choice Model (MCM) was designed to estimate the choice of transport mode for each trip and consists of four (4) models by trip purpose: Home-based Work, Home–based School, Home-based Shopping/Other and Non-Home-Based purposes as shown in Table 2.3.13. The trip-based database from the Activity Diary Survey (ADS) was utilized for this model.

Table 2.3.13 List of MCM Trip Purposes

No.	Trip Purpose
1	Home-based Work
2	Home-based School
3	Home-based Shopping/Other
4	Non Home-based

Source: The Study Team

A multinomial logit model with the four transport modes shown in Table 2.3.14 was adapted for the Modal Choice Model. The variables for this model are presented in Table 2.3.15.

Table 2.3.14 List of Transport Modes

No.	Name of Transport Mode
1	Car
2	Motorcycle
3	Public Transport
4	NMT (Non-Motorized Transport)

Source: The Study Team

Table 2.3.15 List of Variables for Mode Choice Model (MCM)

No.	Attribute	Variable
1	Household	Household Monthly Income
		Household Size
		Vehicle Ownership (Car/Motorcycle)
2	Person	Social Status
		Age
		Relationship with Head of Household
3	Zone	Population Density in a Household TAZ
		Transport Accessibility in Origin and Destination Zones ・ Ratio of formal public transport coverage (%) ・ Ratio of road surface coverage (%)
4	Trip	Impedance by Transport Mode
		Inter-zonal Trips between TAZs or Not

Source: The Study Team

The impedance by transport modes is generalized as a cost between each origin and destination. This generalized cost was defined by fare, vehicle operation cost and travel time cost based on result of the route assignment model. The vehicle operation costs were calculated based on CS and ADS, and these are 349 CDF/km for car and 543 CDF/km for motorcycle.

(6) Additional Trip Table

Prior to running the route assignment model, additional trips were introduced. Additional trips are "trips from external and special generator TAZs" and "inter-zonal freight trips". It is assumed that these trips will not have a significant impact on the result of the transport demand projection in 2017, but that they should nevertheless be considered in order to develop a more reliable transport model. On the other hand, the four-step model does not deal with these trips well, thus the following approaches were used for this Study:

d) Trips from External and Special Generator TAZs

The number of trips in 2017 from external and special generator TAZs was introduced using the results of cordon line and passenger interview surveys from the logistics survey. The five external and special generator TAZs were set in 2017 to accommodate three national and provincial roads, a port, and the N'djili Airport as discussed in sub section 2.3.1.

e) Inter-zonal Freight Trips

The number of inter-zonal freight trips was estimated based on the results of a logistics survey of 74 major freight origins and destinations which included ports, container terminals, and logistics centres. It is noted that this approach does not cover all freight trips; however, the difference between observed traffic volumes and the route assignment projections using this approach was compared through the process of base-year calibration and were found to be acceptable.

(7) Route Assignment Model

The route assignment model is used to determine the route taken between each origin and destination, and includes two assignment processes: highway assignment for private modes, and transit assignment for public transport trips. The two assignment processes are closely related. For example, travel speed for buses depends on road congestion, and travel speed has an impact on modal shift to non-road based transport such as railway and ferry. Thus, iterative calculation was applied for the two assignment processes, and the modal choice model utilizes the results.

The highway assignment process in this Study is daily and vehicle-based with consideration of road capacity reduction due to public transport operations. The individual trips for motorcycles and cars were summarized as Origin-Destination (OD) tables by three income classes and converted to PCU using the PCU factors and average vehicle occupancies shown in Table 2.3.16. Furthermore, the aforementioned additional trips were added to consider external and freight trips. The values of time (VOT) for three income classes and freight transport are shown in Table 2.3.17.

Table 2.3.16 Average Vehicle Occupancy and PCU Factor for Route Assignment Model

Transport Mode		PCU Factor (*1)	Average Vehicle Occupancy
Private Mode	Motorcycle	0.3	1.70
	Car	1.0	2.82
Freight Transport	Light Goods Truck (LGT)	1.5	2.02
	Heavy Goods Truck(HGT)	2.5	2.05
	Articulated Set (ACT)	2.5	2.17
Public Transport	Passenger Van (Van)	1.5	(*2)
	Mini Bus	2.0	(*2)
	Large Bus	2.0	(*2)

*1: PCU factor was discussed at 15th workshop

*2: The average vehicle occupancy was not used for the transit assignment

Source: The Study Team

Table 2.3.17 Values of Time for Route Assignment Model

Trip Type		VOT (CDF/Hour)
Person Trip	Low Income	218
	Middle Income	660
	High Income	2,825
Freight Trip	LGT	1,315
	HGT	1,981
	ACT	2,980

Source: The Study Team

The user equilibrium method with generalized costs was applied for the highway assignment process. The travel time between origins and destinations was converted to a generalized cost using VOT. The speed flow curves are based on the following BPR formula. The BPR formula was proposed by the US Bureau of Public Roads in 1964 in a traffic assignment manual and is currently widely used around the world.

$$\textbf{BPR Function} \qquad t = t_0\left(1 + \alpha\left(\frac{V}{C}\right)^{\beta}\right)$$

Where, t : Travel Time
t_0 : Free flow Time
V : Traffic Volume
C : Road Capacity
α : Parameter (=0.15)
β : Parameter (=4.00)

The transit assignment process is daily and a person-based assignment using the minimum generalized cost for each origin and destination. The generalized cost includes fare, access/egress time, waiting time, walk time and time spent in public transport vehicles. Transfers between public transport routes were also considered in this process.

(8) Base Year Calibration

The Table 2.3.18 and Figure 2.3.5 show a comparison of screen line vehicle counts and model forecasts after the base year calibration. All screen line counts are within an acceptable error range of 10%.

Table 2.3.18 Screen Line Comparison (PCU/day)

Screen Line	Direction	Observed	Estimated	Accuracy (%)
SL A	Both	311,333	287,878	92.0 %
SL B	Both	335,747	316,870	94.4 %

Source: The Study Team

Source: The Study Team

Figure 2.3.5 Compared Screen Lines

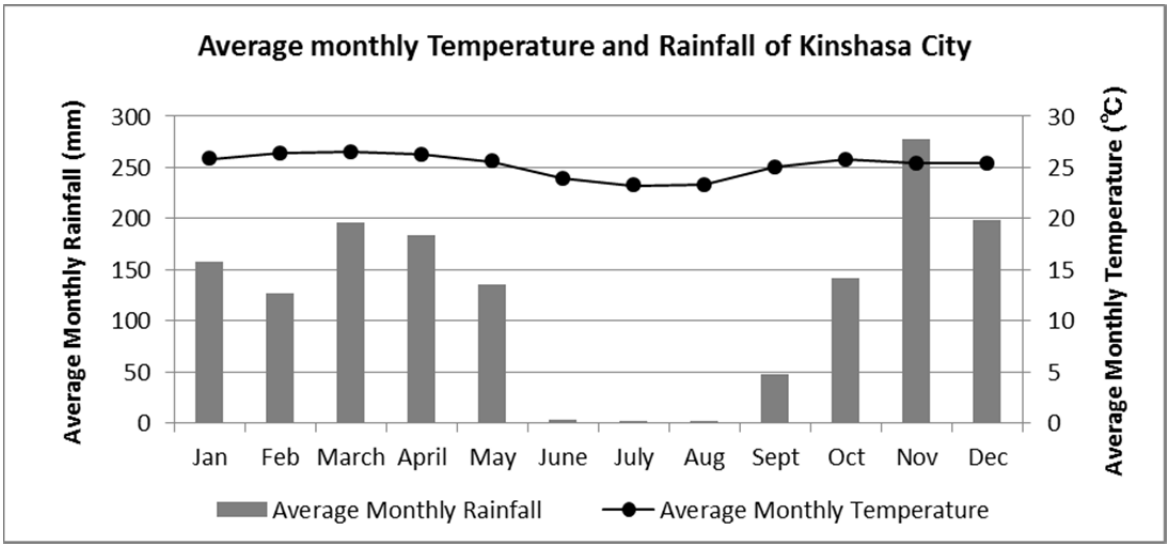
The results of the initial route assignments did not exactly correspond to the observed situation since input data for the transport model includes unavoidable biases; for example, daily and seasonal fluctuations, sample bias, and bias within the socio-economic framework. The base year calibration was implemented based on the difference between total person trips estimated in the route assignments and observed screen line person trips.

CHAPTER 3 Existing Framework Conditions

3.1 Natural Environment

3.1.1 Climate

The climate in Kinshasa City is defined as equatorial savannah with a dry winter in June, July and August, as shown in Figure 3.1.1. The annual average daily high temperature is about 30°C, while the average daily low temperature is about 21°C, and the annual mean temperature is about 25°C. Annual total rainfall is about 1500 mm.



Source: Climate Change Knowledge Portal, World Bank Group

Figure 3.1.1 Average Monthly Temperature and Rainfall in Kinshasa City (at location 4.34 S, 15.30 E) from 1991-2015

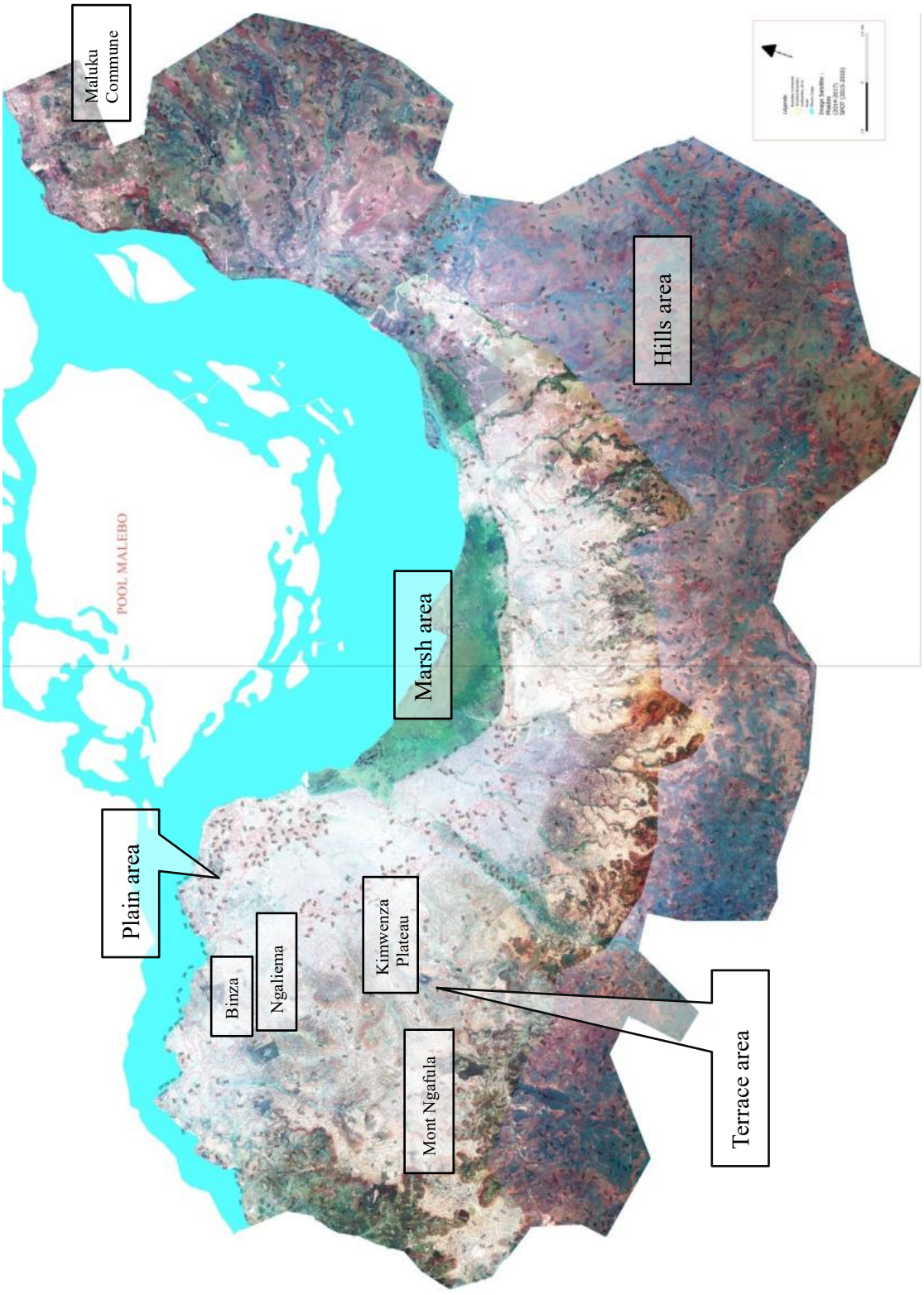
3.1.2 Geology and Topography

(1) Geological and topographical characteristics

The topography of the Study Area is described in Figure 3.1.2. Kinshasa City is located on a contrasted topographic site and is composed of a marshy and alluvial plain varying in altitude from 275m and 300m; hills with altitudes ranging from 310m to 370m consisting of the Ngafula, Ngaliema, Amba hills; and the plateaus of Kimwenza and Binza.

The topography of Kinshasa City is characterized by:

- The Pool Malebo which is a vast lake-like widening of the Congo River dotted with islands and islets located between Kinshasa City and Brazzaville. It is about 35 km long, 23 km wide and 500 km^2 in surface area.
- The Plain of Kinshasa City which is exposed to serious problems generated by the lack of an efficient drainage system. This area extends over nearly 20,000 hectares, from the commune of Maluku at the East to the foot of the Ngaliema hills at the West. The soil is composed of a layer of low sandy alluvial masses located at an altitude between 225m to 260m with an average depth of around 10km.
- The terrace which is a set of low hills (10 to 25 metres) surrounding the plain is located in western part of the Kinshasa City between N'djili and Mont Ngafula. The soil is similar to the plain area. It is composed of soft sandstone deposit mixed with silica and is covering a layer of yellow clay and is covered by a brown silt layer.
- The hills are exposed to erosion and river disasters accelerated by human activities such as agriculture and deforestation.



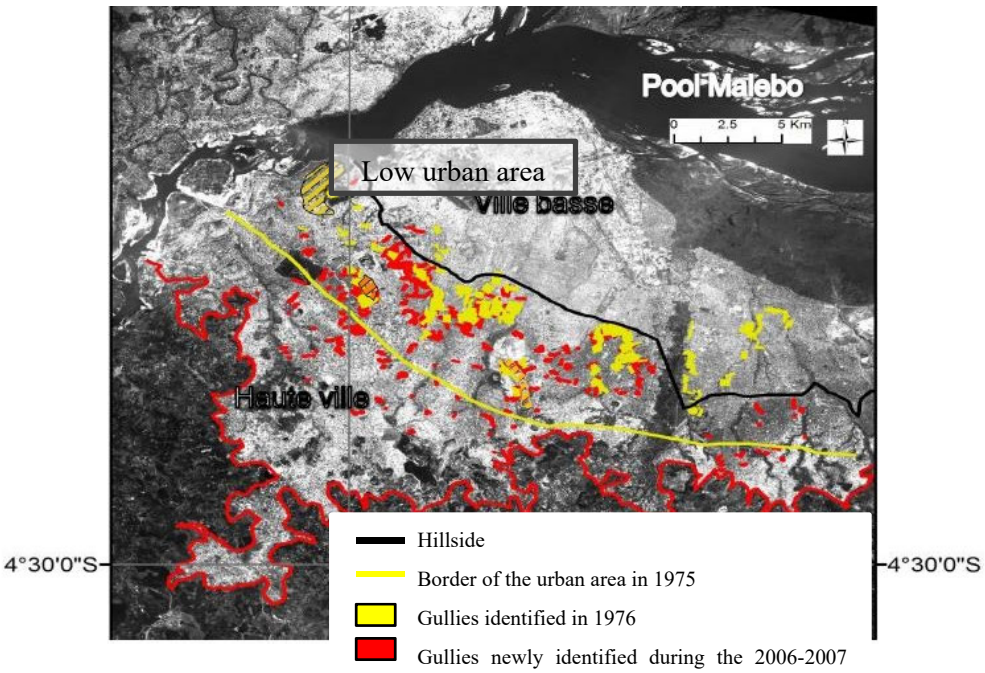
Source: The Study Team

Figure 3.1.2 Topography of the Study Area

(2) Erosion disasters

According to BEAU (*Bureau d'Etude d'Aménagement Urbain* / Urban Planning Office), various studies[1] on geo-disasters in Kinshasa City have been conducted in the past and are continuing with the partnership of academic institutions such as the University of Kinshasa.

Due to the sandy nature of the soil, land coverage and lack or degradation of drainage and rainwater collection systems, Kinshasa City is highly susceptible to gully erosion (e.g. soil erosion generated by running water). A study by Professor Fils Makanzu Imwangana[2], found that mega-gullies (with depths greater than 5 metres) have only developed in Kinshasa City's high town since urbanization started; and that a critical density of houses and road networks is needed to generate the mega-gullying phenomena.



Source: Fils Makanzu Imwangana, Kinshasa en proie à l'érosion en ravine: inventaire cartographique et impact socioéconomique (presentation file_figure3.Urbanisation et risques d' érosion dans la haute ville (1975-2007))

Figure 3.1.3 Map on the Evolution of Erosion in Kinshasa (Prepared by the University of Kinshasa)

3.1.3 River and Watershed

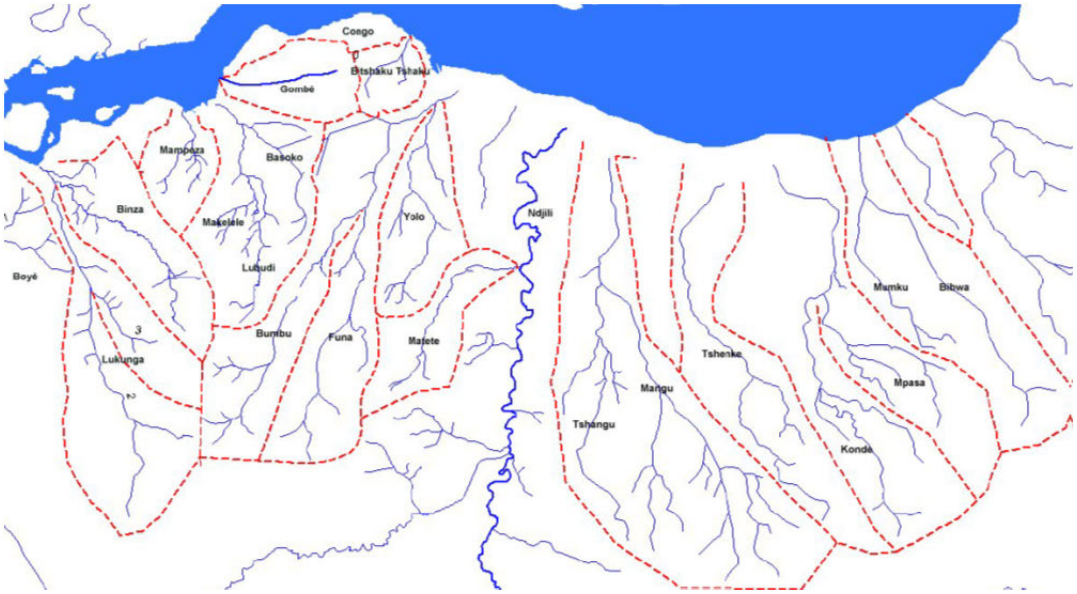
The hydrological network includes the Congo River and its main tributaries on the southern bank, which for the most part cross the City from south to north.

[1] Requests for data, maps and reports on past disasters and studies are ongoing.
[2] Fils Makanzu Imwangana, Ine Vandecasteele, Philippe Trefois, Pierre Ozer, Jan Moeyersons (2005), The origin and control of mega-gullies in Kinshasa (D.R. Congo)

Table 3.1.1 Outline of the Major Watersheds of Kinshasa City

River	Characteristics	Area included in Kinshasa City	Length
Boye	✓ Flow direction: east to west ✓ Communes crossed: north of Mont-ngafula ✓ Other: low risk of erosion and inundation	2,000ha	4,000m
Lukunga and Binza	✓ Flow direction: east to west ✓ Communes crossed: Ngaliema and a part of Mont-ngafula ✓ Other: high risk of erosion	5,700ha	Lukunga: 8,850m Binza: 8,000m
Mampenza	✓ Communes crossed: north-east of Ngaliema ✓ Other: low risk of erosion and inundation	800ha	5,100m
Basoko – Lubudi - Makelele	✓ Flow direction: south to north ✓ Communes crossed: part of Bandalungwa, Kintambo, Ngaliema, Ngiri-ngiri, Bumbu and Selembao ✓ Other: Erosion risk in Ngaliema and problems of drainage due to waste disposal	2,850m	Basoko: 7,000m Lubudi: 6,000m Makelele: 9,500m
Fleuve Congo	✓ Communes crossed: north part of Gombe ✓ Other: saturated outlet	500ha	-
Gombe	✓ Flow direction: east to west ✓ Communes crossed: originates from Lingwala and drains Gombe, Kinshasa, Lingwala, and Bandalungwa ✓ Other: almost buried	1,000m	4,400m
Bitshaku-Tshaku	✓ Communes crossed: part of Barumbu and Kinshasa ✓ Other: buried in the eastern industrial zone of Gombe	7,150ha	Bitshaku: 14,300m Tshaku: 9,800m
N'djili	✓ Flow direction: south to north ✓ Communes crossed: Mont-ngafula, Matete, Limete Résidentiel, Kimbanseke, N'djili and Masina, ✓ Other: zones where the population is growing and human activities are causing pollution problems and changes in runoff	6,850ha	20,800m
Matete	✓ Flow direction: south to north ✓ Communes crossed: Lemba, Matete, Kisenso and Limete Résidentiel. ✓ Other: tributary of the N'djili river	1,300ha	10,600m
Tshangu-Mangu	✓ Flow direction: south to north ✓ Communes crossed: Kimbanseke and Masina	7,500ha	31,500m
Tshuenge	✓ Flow direction: south to north ✓ Communes crossed: part of Kimbanseke, N'sele and Masina	3,400ha	11,100m
Konde – Mpasa	✓ Communes crossed: N'sele	7,300ha	8,700m
Bibwa – Munku	✓ Communes crossed: N'sele	3,800ha	10,300m

Source: Théodore LOKAKAO ILEMBA and Eugène SHAMBA NZITATIRA (2015), MONOGRAPHIE DE L'EAU DE LA VILLE DE KINSHASA



Source: SOSAK (Strategic Orientation Scheme for the Kinshasa metropolitan Area)

Figure 3.1.4 Major Rivers

Kinshasa City has suffered from many floods in the past and the risk of inundation in the densely populated districts of Funa and Lukunga is high because of the Kalamu River. The main causes[3] of flooding in Kinshasa City are said to be the following:

1) Meteorological phenomena such as El Niño
2) Heavy rains in Kinshasa City and areas upstream
3) Urbanization changing the soil coverage (e.g. discharge conditions)
4) Insufficient and degraded drainage systems
5) Uncontrolled or informal land use in valleys, especially in flood prone areas along the N'djili River
6) Uncontrolled land use in hill areas causing: a) sedimentation of the rivers resulting from erosion of upstream areas, and b) decreased vegetation on steep slopes
7) Increased solid waste disposal in rivers
8) Insufficient storm water collection facilities in hill and low areas (to avoid erosion)
9) Decreased vegetation throughout the entire area

Table 3.1.2 below describes major inundations in the past[4].

[3] Joseph- Dieudonné, Dr LUBOYA KASONGO MUTEBA(2002), Etude systémique du bassin versant de la rivière N'djili à Kinshasa
[4] Requests for more detailed and recent information are ongoing.

Table 3.1.2 Major Disasters Caused by Rivers Flooding

Date	Location	Meteorological/hydrological characteristics	Outline of the Damage
1961 Dec.17	Low areas along Congo River	✓ Historical flood generated by El Niño ✓ The water level reached 6.26m ✓ 63 days of flooding (high water level)	✓ All the communes in the low laying areas were flooded: Limete, Gombe, Barumbu, Lingwala, Masina and Ngaliema
1990 May 20-21	Makelele River and Lubudi River	✓ Intensive rainfall (100mm/ 2 hours) ✓ Rivers of Lubudi and Makelele overflowed ✓ Destruction of 2 storm water reservoirs (capacity of 1,680 x $2m^3$)	✓ 41 deaths and 57 missing in the communes of Ngaliema, Bandalungwa, and Kintambo ✓ 70 homes destroyed in the communes of Ngaliema, Bandalungwa, and Kintambo (more than 100 homes in total) ✓ 2,000 homeless
1998 March 26-27	Communes of Ngaliema, Kisenso, Mont-ngafula, Selembao, Matete, and Mabdalungwa		✓ Around 20 deaths ✓ Hundreds homeless ✓ Destruction of homes, roads, bridges at Kinsuka (Ngaliema) ✓ Critical erosion in Kisenso, Mont - Ngafula, Selembao and Ngafani ✓ More than 2,562 families affected (1,524 in Matete, 1,000 in Bandalungwa, 38 in Mont – Ngafula)
1999 Nov to 2000 Feb	Congo River, N'djili River	✓ The rise of the water level of Congo River was remarkable (Usually, the water level of this wide river is around 3.70m. During the 1999-2000 floods, the level reached 5.43m, which is the higher after the exceptional 1961 floods). ✓ Tributaries such as N'djili River flooded due to backwater	✓ More than 65,000 were affected ✓ Communes affected: Ngaliema, Barumbu, Matete, N'djili, Limete, Kisenso, Masina, Kinkole (Nsele), Maluku, Ngaba, Makala, Bumbu, and Lemba.
2001 May 17	Lubidi River	✓ Destruction of the two storm water basins at Lalu (Mbinza Delvaux and Mbinza Pigeon Melmeza)	✓ More than 50 deaths
2002 March	Communes of Matete, Masina, Limete and Kinsengo along N'djili River	✓ The increase of the N'djili River was slow (increase of 1 metre that caused overflow)	✓ 5,870 were affected ✓ 711 homes damaged ✓ 32 roads affected ✓ Since the increase of the water level was slow, there was enough time to evacuate people
2006 April 9	Kisenvo commune (Bikanga)	✓ Torrential rains fell in Kinshasa City from April 8 to 10, 2006	✓ 3 deaths

Date	Location	Meteorological/hydrological characteristics	Outline of the Damage
		✓ Mudslides occurred	
2007 Oct. 25-26	Western part of Kinshasa City (rivers of Makelele, Lubudi, Lukunga, and Bumbu)	✓ Heavy rains (228mm of rainfall recorded at Mbinza Station during the night)	✓ 31 deaths ✓ Affected communes: Kisenso, Limete, Matete, Masina, Kimbanseke
2015 Feb	Low area of Kingabwa, Ndolo		✓ More than 11,000 affected ✓ 1,500 homes damaged ✓ Cost to rehabilitate drainage system was estimated at USD1.6 million

Source: LELO NZUZI F(2008), Kinshasa : Ville et Environnement ; Joseph- Dieudonné, Dr LUBOYA KASONGO MUTEBA(2002), Etude systémique du bassin versant de la rivière N'djili à Kinshasa , IFRC's disaster information bulletins

3.1.4 Flora, Fauna and Protected Areas

According to WWF (World Wide Fund for Nature), Kinshasa City is located in a biome area named 'Tropical and subtropical grasslands, savannas and shrublands' Large expanses of land in this area do not receive enough rainfall to support extensive tree cover. Grasses dominate the composition of flora species of these eco-regions, although scattered trees may be common.

Restoration potential in these systems is high, but ploughing, overgrazing by domestic livestock, and excessive burning can quickly degrade and alter natural ecosystems. Alteration of surface water patterns can have significant impacts on the persistence of many vertebrate species, and many species are highly sensitive to low-intensity hunting or other human activities.

As seen in Figure 3.1.5, landscape in the Study Area is either artificial or semi-artificial. It is assumed that fauna in the Study Area no longer supports large mammalian wildlife.

A view from Matadi Road

At the south-west corner of Kinshasa City

Source: The Study Team

Figure 3.1.5 Vegetation in the Study Area

WWF is operating various conservation programs for the Congo Rainforest and Basin area. As shown in Figure 3.1.6, the areas targeted by WWF for conservation are located north of Kinshasa City.

Source: WWF, https://www.worldwildlife.org/places/congo-basin

Figure 3.1.6 WWF Target Area (in Brown) for Conservation Program of Congo Rainforest and Basin

According to the Annuaire statistique 2014, p.297, there are 25 areas for conservation in the DRC (Democratic Republic of the Congo) shown in Table 3.1.3. Out of which, Parc Président Mobutu (de N'sele) and Réserve naturelle de Bombo-Lumene are located in Kinshasa City, and the former is located within the Study Area (Figure 3.1.7). Official detailed information about the Nature Reserves has been requested to ICCN (*Institut Congolais pour la Conservation de la Nature* / Congolese Institute for Nature Conservation).

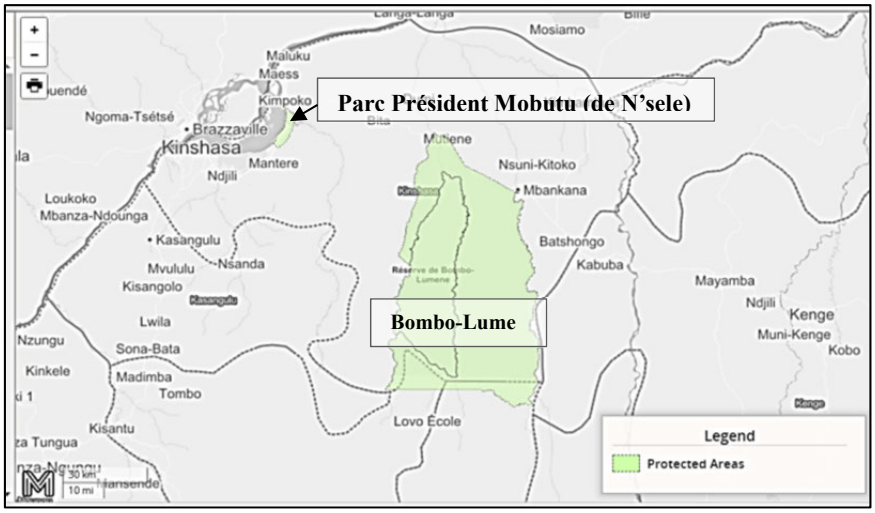
The President Mobutu Park (*Parc Président Mobutu (de N'sele)*) (Figure 3.1.7) was developed as a model farm for agriculture development in 1966, but was abandoned in 1991 and is currently used as a residential lot. Therefore, despite the fact that there may be restrictions on land use, the reasons for such designations may not always be for nature conservation.

The Bombo-Lumene Nature Reserve was designated in 1976 and covers 3.5 km^2 of the south-east corner of Maluku Commune. Its northern border is located more than 30km from the border of the Study Area (Figure 3.1.8).

Table 3.1.3 Areas for Conservation in the DRC

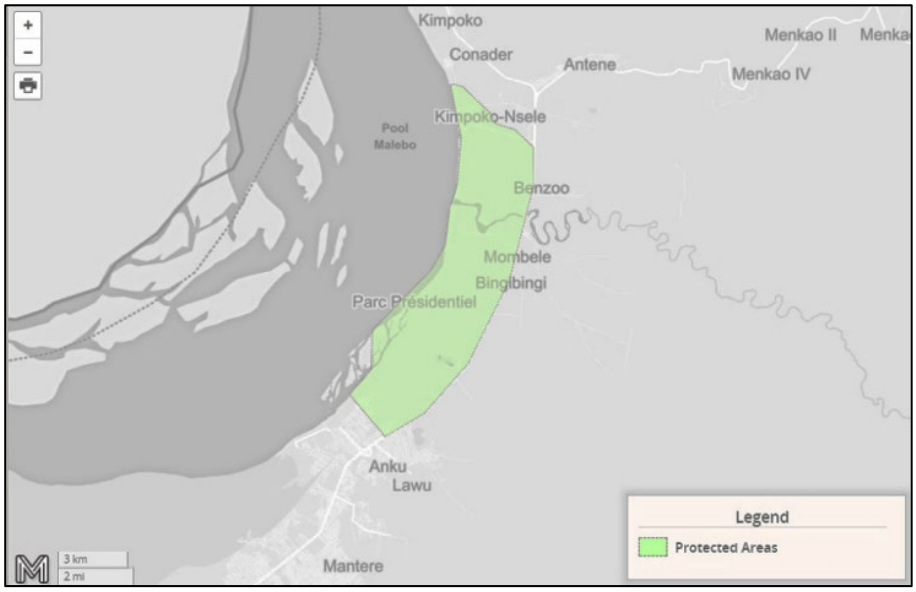
Type		Name	Province(s)
National Park	1	Garamba	Haut-Uele
	2	Maiko	Maniema, North Kivu, Tshopo
	3	Virunga	Nord-Kivu
	4	Salonga	Equateur, Mai Ndombe, Kasai, Sankuru
	5	Kahuzi biega	South-Kivu
	6	Upemba	Haut-Lomami
	7	Kundelungu	Haut-Katanga
Biosphere Reserve	1	Yangambi	Tshopo
	2	Luki	Kongo Central
	3	Lufira	Haut-Katanga
Scientific Reserve	1	Luo	Tshuapa
Wildlife Reserve	1	Bomu	Bas-Uele
Nature Reserve	1	Okapi Wildlife Reserve	Tshuapa
	2	Mangroves National Park (Muanda Marine Reserve)	Kongo Central
	3	Parc Président Mobutu (de N'sele)	Kinshasa
	4	Sankuru Natural Reserve	Sankuru
	5	Lomako Forest Reserve	Mongala
	6	Tayna Nature Reserve	North-Kivu
	7	Itombwe Nature Reserve	South-Kivu
	8	Primate Nature Reserve (Kisimba Ikobo)	North-Kivu
	9	Tumba- Lediima Nature Reserve	Equateur
	10	Kokolopori Bonobo Reserve	Tshopo
	11	Ngiri Reserve	Equateur
	12	Sarambwe Reserve	North-Kivu
	13	Bombo-Lumene National Park	Kinshasa

Source : DEP/ SG- ECN ; ICCN 2013 et WRI 2011, Annuaire statistique 2014 p.297



Source:http://rdc.moabi.org/appui-a-l-implication-des-communuates-locales-dans-la-gestion-de-la-reserve-de-bombo-lumene-a-kinshasa/fr/#9/-4.6421/16.0236&layers=moabi_protected

Figure 3.1.7 Location of Nature Reserves



Source:http://rdc.moabi.org/appui-a-l-implication-des-communuates-locales-dans-la-gestion-de-la-reserve-de-bombo-lumene-a-kinshasa/fr/#9/-4.6421/16.0236&layers=moabi_protected

Figure 3.1.8 Detailed Location of the Parc Président Mobutu (de N'sele)

3.1.5 Pollution

By visual observation, the major sources of air pollution in Kinshasa City include vehicle exhaust, earth dust from unpaved roads and ground surface, smoke from unregulated waste burning, and smoke from waste collection points (Figure 3.1.9). Also, charcoal and firewood used for cooking are domestic sources of air pollution.

As for noise pollution, it was found that noises such as music and the voices of bus conductors are collectively larger in most cases than the noise from running vehicles (Figure 3.1.10).

	
Vehicle exhaust gas	**Dust from unpaved road and ground surface**
	
Smoke from unregulated waste burning	**Smoke from waste collection points**

Source: The Study Team

Figure 3.1.9 Observed Primary Sources of Air Pollution

	
A roadside shop playing loud music to attract customers	**Competing buses and taxis at a market**

Source: The Study Team

Figure 3.1.10 Observed Primary Sources of Noise Pollution

As for water pollution, sewage treatment is largely non-existent. Domestic kitchen and bath waste water and rain water flows into open ditches in alleys then flows into open or covered ditches along main roads. Where the ditches along the main road are filled with earth and garbage, the water freely flows over the road surface. Rivers that receive the waste water flow slowly and show few signs of aquatic life, except for occasional plant clusters in or near water (Figure 3.1.11).

	
Domestic waste water flowing into road right-of-way	**River and waste water on road**

Source: The Study Team

Figure 3.1.11 Rivers and Waste Water Ditches

3.1.6 Waste Management

Two landfill sites, one in the east and one in the west, are in operation in Kinshasa City.

Waste and recyclable collectors are commonly seen on streets (see Figure 3.1.12). The volume of waste generated, however, surpasses the capacity of collection. Piles of waste are seen in front of every market, where fresh vegetables and fish often sit side-by-side with the waste.

Waste collection centres are located on major roads at regular intervals. All the waste centres observed were found to be full, and it appears that the small capacity of waste trucks to collect and transport waste to the landfill sites is the most serious bottleneck in Kinshasa City's waste management system.

Dirt and waste in roadside ditches is cleaned by workers. A survey is underway to assess governmental resources and capacity (manpower, budget, etc.) to accomplish this work, as well as to coordinate waste collection.

	
Waste accumulation at market	**Ditch cleaning work**
	
Collection of waste and recyclables	**Waste collection centre on main road**

Source: The Study Team

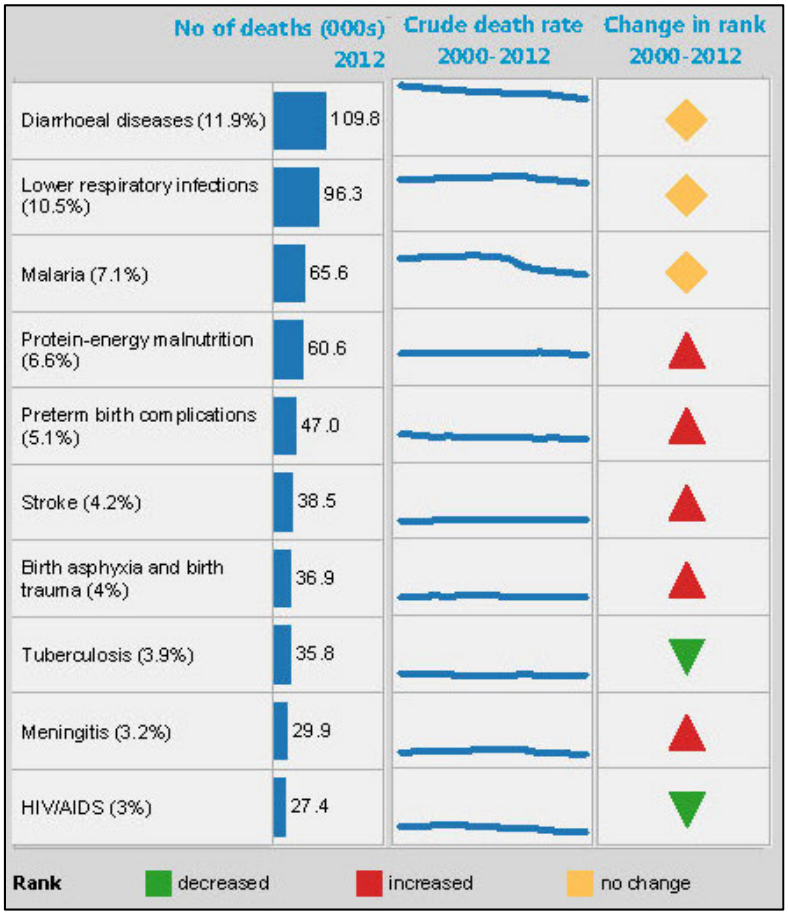
Figure 3.1.12 Waste Management

3.1.7 Major Diseases and Causes of Death

According to WHO (the World Health Organization), life expectancy at birth in the DRC in 2015 was 58 for males and 62 for females. In 2013 in the DRC the median age of the population was seventeen years old, the ratio of the population living in urban areas was 42%, and gross income per capita was $680.

Also in 2013, the under-five mortality rate per 1,000 live births was 119, and the maternal mortality rate per 100,000 live births was 730. The primary causes of death in children under-5 were acute respiratory infections (16% of total deaths), malaria (15%), premature birth (13%), diarrhoea (11%), and birth asphyxia (10%).

The top ten causes of death for the whole population in 2012 are shown in Figure 3.1.13. Diarrhoeal diseases were the leading cause of death, killing 109,800 people. Malaria was the third, tuberculosis was the eighth. HIV/AIDS was the tenth leading cause of death, claiming 27,400 lives.



Source: Democratic Republic of the Congo: WHO statistical profile, http://www.who.int/gho/countries/cod/country_profiles/en/

Figure 3.1.13 Top 10 Causes of Death in DRC in 2012

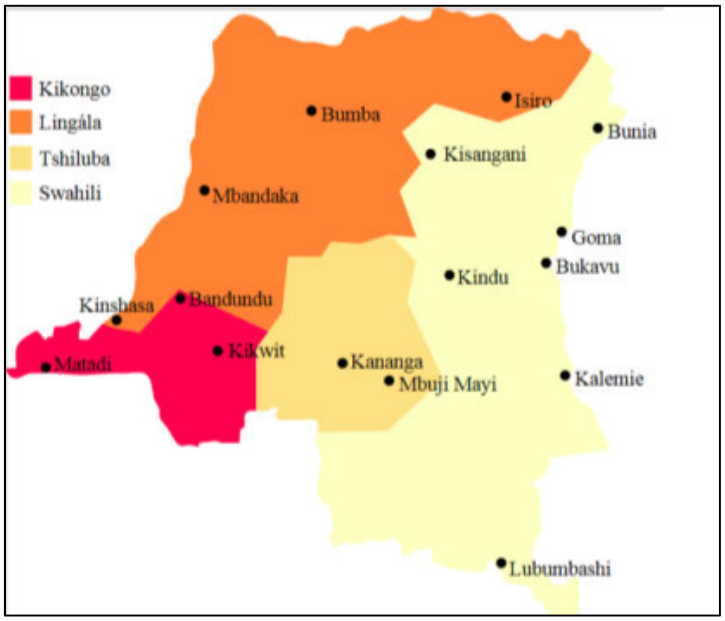
According to NCPI (the National Commitments and Policies Instrument) 2014 submitted to UNAIDS (Joint United Nations Programme on HIV and AIDS), the following populations are identified as key populations and vulnerable groups for HIV programs in the DRC: people living with HIV, men who have sex with men, migrants and mobile populations, orphans and other vulnerable children, people with disabilities, prison inmates, sex workers, women and girls, young women and young men, pregnant women, and miners.

The DRC experienced outbreaks of yellow fever in 2016 and the Ebola virus in 2017.

3.1.8 Language and People in Kinshasa City

The majority of the population in the DRC is multi-lingual. While French is the official language of the country, the DRC also has four 'national' languages: Lingala, Kikongo, Tshiluba and Swahili. All education, including elementary school, is taught in French. Besides French, Lingala is the most common language in Kinshasa City (Figure 3.1.14). In case a person in Kinshasa City is not fluent in French, he/she would not experience difficulty communicating in Lingala or the second most common national language, Kikongo. In rural areas of the DRC, people usually speak one of the four national languages and French in addition to the dialects of the local community,

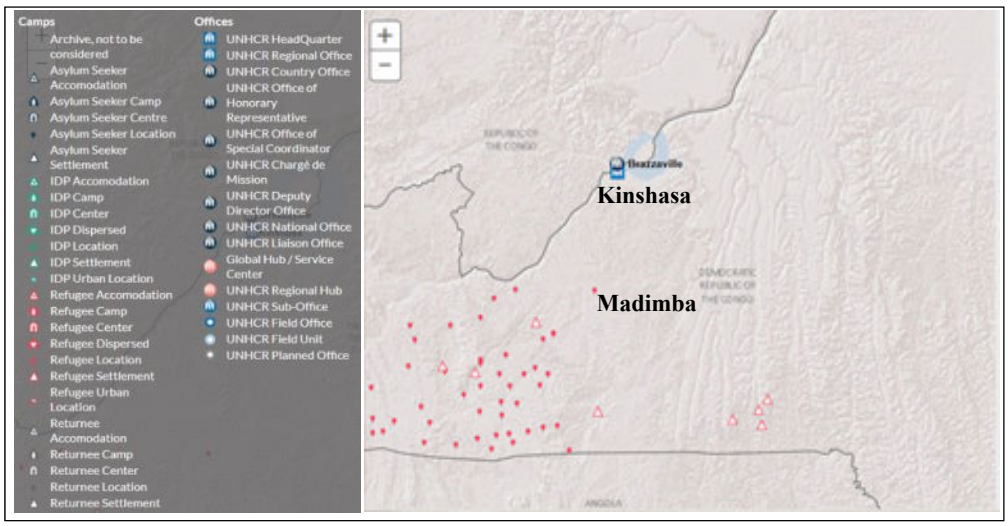
of which there are about 250 in total. In the eastern part of the country, English is also commonly used.



Source: http://www.axl.cefan.ulaval.ca/afrique/czaire.htm

Figure 3.1.14 Distribution of the Four National Languages in the DRC

Currently, the DRC is generating, as well as accepting, a large number of refugees and internally displaced people. According to UNHCR (United Nations High Commissioner for Refugees), a refugee location is recognized in Madimba, Bas Congo Province, about 50 km southwest of the Study Area. There are no camps or settlements for refugees, returnees or internally displaced peoples in the Study Area.



Source: UNHCR camp, office, refugee locations, http://reporting.unhcr.org/node/4874

Figure 3.1.15 Distribution of Refugee Locations near Kinshasa

3.1.9 Cultural and Historical Resources

There are no laws that designate cultural and historical resources for conservation in the DRC. A 2010 publication 'Kinshasa Architecture et paysage urbains' (ISBN-978-2-7572-0362-0, available for purchase at BEAU) lists 127 monumental architecture structures and ancient trees. Those locations and identities shall be incorporated in the GIS data that will be the basis for the formulation of the development scenario alternatives.

3.1.10 Gender Issues

In the 2015 UNDP Human Development Report, DRC ranked 153rd among 159 countries in Gender Inequality Index. Population percentage with at least some secondary education among population 25 and older was 14.5 % for female and 35 % for male. Labour force participation rate was about 70 % for both groups. Looking at statistics of Kinshasa City, the situation is rather different. According to the Second Demographic and Health Survey 2013-2014 (DEUXIÈME ENQUÊTE DÉMOGRAPHIQUE ET DE SANTÉ (EDS-RDC II 2013-2014)), 63 % women decides on the use of their own earnings, compared to national average of 28.6 % and rural average 21.1 %. Although 67.6 % of women earn less than their spouses, 18.7 % of women earn more than their spouses, compared to national average of 9.5 %. In national average, 46.8 % of male own their houses (so do 37.3 % of female) and 43 % of male own the land (so do 34.2 % of female). On the other hand, about 90 % of male and female residents in Kinshasa City do not own their houses, and about 95 % do not own their land. In general, no significant discrimination against women was observed in the urban areas of Kinshasa City. The results from the ADS (Activity Diary Survey) shall be analysed as gender segregated data to understand unique behaviour patterns for both genders and assess the benefits and disadvantages of proposed transportation policies on them.

3.2 Existing Social and Economic Conditions

3.2.1 Population

(1) Estimation Process of Current Population

The following is a basic approach to estimate the current population of Kinshasa City.

- Verification of Benchmark Population in 2013

  - Verification of appropriateness of population in 2013 estimated by SOSAK:

  The Study referred to various data sources including the UN estimate and sets the year 2013 as the benchmark population of Kinshasa City in order to review the SOSAK estimate.

  - Verification of appropriateness of population growth rate:

  The Study analysed increasing rates of population for both natural and social growth by comparing relevant study documents. Reflecting the above comparative analysis, the Study sets the future population growth rate.

- Estimation of Present Population in 2017

  - Estimation of 2017 population: according to the above mentioned values, i.e. i) number of the referential population, and ii) population growth rate, the population of Kinshasa City

in 2017 was estimated.

- Based on the estimated population of Kinshasa City in 2017 and relevant data on population density, the population of respective communes were estimated.

(2) Comparison of Estimated Population of Kinshasa City by the Existing Reference

1) Available References for Current Population Estimation

The following data sources can be referred to for estimating the current population of Kinshasa City.

- Result of Census

In DRC, no census survey has been conducted since 1984. There are several statistics on the current population of Kinshasa City and of the country, but all of them are based upon numbers of assumptions. For setting the current population of the Study Area and of Kinshasa City, it is necessary to verify the estimation process and preconditions of each reference.

- Benchmark population in 2013 is estimated by Registered Numbers of Population for Election (2005) and its Distribution Ratio of Age (18 years +)

SOSAK estimated benchmark population in 2013, based on registered number of population for election (2005) and its distribution ratio of age eighteen years old and over. This population estimated by SOSAK shows lower than the population estimated by INS (*Institut National des Statistiques* / National Statistical Institute).

The smaller number of registered population are considered attributable to the reason that the registration procedure for election in DRC requires electors to go to the administrative office and it takes a long time waiting at the office and many people, such as the old aged and migrant persons are supposed to be out of registration procedure. Therefore, the SOSAK estimate tends to be smaller than the real population number.

SOSAK also took the distribution ration of age of 2001 for estimating the total population of Kinshasa City in 2005 as shown in Table 3.2.1.

Table 3.2.1 Index for estimation of population of Kinshasa City based on registration numbers of election by SOSAK

Item	Numbers	Reference, remarks
Registration numbers of election (2005) (a)	2,962,779 persons	CEI (Commission électorale indépendante: Independent Electoral Commission)
Composition of population by age (18 years and more) (2001) (b)	46.7%	MICS (Multiple Indicator Cluster Surveys by UNICEF 2001)
Estimated population of Kinshasa City (2005) (a/b)	6,344,280	Rounded

Source: SOSAK DEFINITIF S4, P35

- Administrative Counts (*Comptage administratif*) by Commune

Each commune estimates their population by totalling the reported numbers by chiefs of quartier and street leaders to count. The number is not based on natal registration and its counting and recording measures are not unified. In addition, some residents such as living-in workers, recent migrated persons into relatives could be omitted easily from the counting.

- Other References

Statistics of service population for medical centres are available and can be used for an estimation of the population. However, some areas of the Study Area are not covered with the service area of medical facility. So it is not considered suitable to base the estimation of Kinshasa population upon the statistics of the medical centres.

2) Estimated Population by SOSAK

Eventually, SOSAK in its study referred to:

- Population estimate based on the population registered for election in 2005 and their distribution ratio of age which is derived from 2001 MICS's estimate,
- INS statistics (2000~2013) and estimate for 2015,
- SOSAK's own estimates (of which method are not clearly defined), and
- Administrative counts by communes.

Table 3.2.2 summarizes several population estimates discussed in the SOSAK report.

Table 3.2.2 Estimated Population by SOSAK and INS

Year	SOSAK (based on registered population for election)	SOSAK*1	INS *2	Administrative Counts by Commune
2000		6,200,000	6,062,000	4,229,366
2005	6,344,280		7,255,000	4,912,455
2010			8,683,000	
2013		8,200,000	10,558,000	
(2015)			(11,575,000)*3	

Source: The Study Team

*1 SOSAK DEFINITIF S4, P35

*2 Annuaire statistique 2014 (INS + UNDP), July 2015

*3 INS estimates the population in 2015, based on statistics in the previous years

Consequently, SOSAK elaborated the above sources of population estimates and exhibited without final judgement two different numbers of population as the 2013 benchmark population, they are:

- 10,558,000 (as the estimation in 2013 based on INS statistics)
- 8,200,000 (as the estimation in 2013 by SOSAK consultant)

3) Conclusion by the Study

The Study evaluated the reliability of estimating process made by respective sources of population estimates and consistency of data in the past and continuity of that in future. Finally, the Study adopted the 2013 benchmark population and 2015 population estimate made by INS as follows:

- Population of Kinshasa City in 2013: 10,558,000
- Population of Kinshasa City in 2015: 11,575,000

(3) Difference between the Kinshasa City and the Study Area

The Kinshasa population mentioned in the previous section corresponds to that of Kinshasa City. The Study Area is part of Kinshasa City and the population of some communes need to be identified either "inside" or "outside" the Study Area.

Study Area

Kinshasa City

Source: The Study Team and De Saint Moulin, 2005

Figure 3.2.1 The Study Area and Kinshasa City

The Study identified the difference between the two areas and estimated the population of "inside" and "outside" of the Study Area as shown in Table 3.2.3.

The Study Area doesn't cover all areas of the communes in the four communes (Mont-ngafula, Kimbanseke, N'sele, Maluku). All the communes except for Maluku, are almost covered by the Study Area but small areas outside the Study Area are limited and observed as non-urbanized or non-cultivated areas. Thus, the Study treats all the populations in these three communes as "inside" the Study Area.

For Maluku Commune, the Study grasped the population "inside" the Study Area as of 2016 by referring to information derived from concerned quartiers. Based on this information, the Study estimates the population distribution between "inside" and "outside" the Study Area as shown in Table 3.2.3.

Table 3.2.3 Commune Population "inside" and "outside" the Study Area

Commune	Difference of the area	Distribution of Commune Population	
		"inside" the Study Area	"outside" the Study Area
Mont-ngafula	Small difference in west and south of the commune	Evaluated that most of the population is included in the Study Area	Considered negligible small in number
Kimbanseke	Small difference in west and south of the commune	Evaluated that most of the population is included in the Study Area	Considered negligible small in number
N'sele	Small difference in west and south of the commune	Evaluated that most of the population is included in the Study Area	Considered negligible small in number
Maluku	The Study Area covers only small part of the whole commune area	225,522 persons are counted as the result of survey for the 6 quartiers in the study area (2016)	Remaining population
Other communes	The Study Area fully covers the commune areas	All area is covered by the Study Area	None

Source: The Study Team

(4) Estimation of Current Population Growth in Kinshasa City

The recent statistics of population in Kinshasa City is that of 2015 estimated by INS. For deriving the current population in 2017, it is necessary to estimate a corresponding population growth rate from 2015 to 2017.

1) Available References for Estimation of Population Growth

The following references are available for population growth of DRC and Kinshasa City.

- The whole country
  - MICS
  - Annual statistics of INS which applies the same growth rate between 2001 and 2014
  - Population estimates prepared by the UN Population Division and which deals with the population of the whole DRC between 1950 and 2100.
- Kinshasa City
  - SOSAK (SOSAK DEFINITIF S4, P37) indicates the population growth rates of Kinshasa City between 1910 and 2013 by quoting from several references
  - "Annual Statistics (Annuaire Statistique)"of INS shows the population growth rates of Kinshasa City. Those growth rates seem to be composed of the estimation numbers for every four years and correction numbers for every five years.

Table 3.2.4 shows the estimated growth rates of population by representative statistical data sources.

Table 3.2.4 Assumption of the Distribution of Population of Communes "in" and "out of" the Study Area

Year	The whole DRC		Kinshasa City		
	INS *1	UN Population *2	SOSAK *3	INS *1 (original)	INS *4 (average by the Study Team)
2001	3.40	3.10	3.60	4.70	4.35
2002	3.40	3.10	3.60	3.40	4.35
2003	3.40	3.10	3.60	3.40	4.35
2004	3.40	3.10	3.60	3.40	4.35
2005	3.40	3.24	4.70	3.40	4.35
2006	3.40	3.24	4.70	4.70	4.35
2007	3.40	3.24	4.70	3.40	4.35
2008	3.40	3.24	4.70	3.40	4.35
2009	3.40	3.24	4.70	3.40	4.35
2010	3.40	3.17	4.70	3.40	4.35
2011	3.40	3.17	4.70	10.90	4.35
2012	3.40	3.17	4.70	4.70	4.35
2013	3.40	3.17	N/A	4.70	4.35
2014	3.40	3.17	N/A	4.70	4.35
2015	N/A	3.09	N/A	N/A	N/A

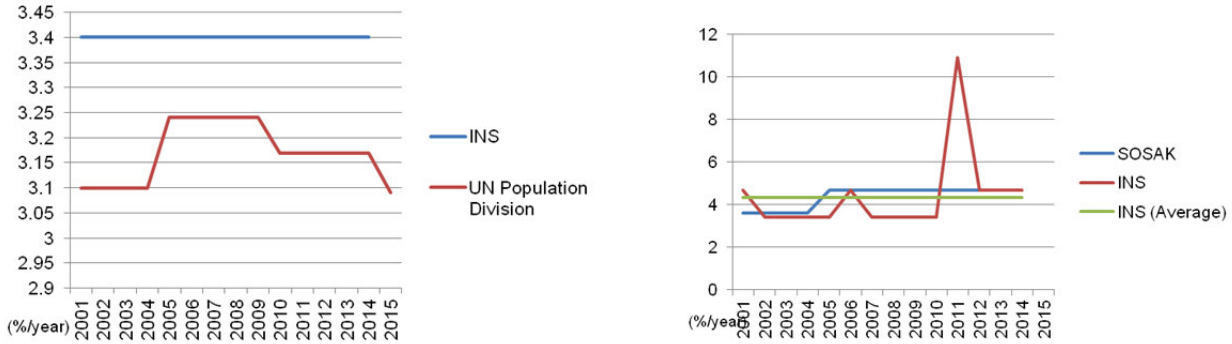
Source: The Study Team

*1 Annuaire statistique 2014 (INS + UNDP), July 2015

*2 United Nations Population Division, World Population Prospects: the 2015 Revision

*3 SOSAK DEFINITIF S4, P37

*4 The average annual growth rate is calculated, based on the original numbers of Kinshasa City population made by INS



Source: The Study Team

Figure 3.2.2 Annual Rate of Population Change of DRC (Left) & Annual Rate of Population Change of Kinshasa City (Right)

2) Estimation of 2017 Population in Kinshasa City

Compared to the average growth rate of DRC and that of Kinshasa City (INS's estimates in Table 3.2.4), the latter indicates about 1% higher than that of DRC.

UN Population Division, which is one of the most reliable sources for discussing future population growth, analyses demographic factors such as birth rate, mortality rate, and demographic structure for estimation. The UN exhibits the estimated annual population growth rate of the whole DRC as 2.94% (low variant) to 3.24% (high variant) for the years of 2015 to 2020.

Taking into accounts the above analysis, that is, a difference in population growth between DRC and Kinshasa City and the population growth rates estimated by UN for DRC between 2015 and 2020, an average growth rate between 2015 and 2017 is assumed to be 3.94% (low variant) to 4.24% (high variant).

As the consequence, the population of Kinshasa City is estimated at 12,505,000 (low variant) to 12,577,000 (high variant) in 2017. The Study, for the moment, takes these estimates as the 2017 benchmark population of Kinshasa City.

Table 3.2.5 Estimated Population of Kinshasa City in 2017

Year and source of estimates	Annual population growth (2015 to 17)		Population of Kinshasa City
	DRC	Kinshasa City	
2015 (INS)	-	-	11,575,000
2017 (UN, low variant)	2.94 %	3.94 %	12,505,000
2017 (UN, medium variant)	3.09 %	4.09 %	12,541,000
2017 (UN, high variant)	3.24 %	4.24 %	12,577,000

Source: The Study Team

(5) Distribution of Population by Commune

1) Available References for Estimation of Population Growth

There are three sources to be referred to for the population of Kinshasa City by commune level. The recent one is that of INS, the population as of 2013. And others are of 1984 and 2004. In order to calculate each commune's population, the INS statistics conducted counting surveys in sample areas, and then estimated the population in other remaining areas.

Table 3.2.6 Available Sources and Statistical Population by Commune of Kinshasa City

Commune and categories	INS*1	Ministere de Plan*2	INS*1
	1984	2004	2013
Residential Area			
Gombe	17,360	32,373	70,594
Limete	128,197	375,726	435,720
Ngaliema	252,151	683,135	977,485
Old City			
Kintambo	49,297	106,772	152,918
Barumbu	69,147	150,319	165,720
Kinshasa	74,708	164,857	152,778
Lingwala	49,173	94,635	129,439
New City			
Ngiri-ngiri	82,303	174,843	167,019
Kasa-vubu	74,888	157,320	114,152
Planned City			
Kalamu	160,719	315,342	287,045
Lemba	159,775	349,838	449,429
Matete	104,902	268,781	330,177
Bandalungwa	97,214	202,341	322,313
N'djili	157,010	442,138	578,411
Southern Suburbs			
Ngaba	74,447	180,650	258,057
Selembao	126,589	335,581	418,925
Bumbu	113,968	329,234	536,018
Makala	108,939	253,844	304,615
Urban Periphery			
Kisenso	117,774	386,151	514,565
Masina	158,080	485,167	897,980
Kimbanseke	353,209	946,372	1,407,437
Mont-ngafula	52,820	261,004	487,722
N'sele	28,963	140,929	527,305
Maluku	2,676	179,648	872,175
Total	**2,614,309**	**7,017,000**	**10,558,000**

Source and Note: Total numbers shown in Table 3.2.6 are recalculated by the Study, so that they are not necessarily the same as the original numbers.
*1 INS (2013) (SOSAK Definitif S4, P41)
*2 DRC, Ministere du Plan (Lero Nzuzi, Kinshasa ville et Environment, P68)

2) Population Growth Rate by Commune

a) Population Growth rate by Commune and Evaluation (2004 to 2013)

Based on population statistics of Kinshasa City of 2004 and 2013, the Study calculated the average annual growth rate of population for each commune.

The Study examines each commune's recent population growth and population density with its spatial land use changes which were obtained by comparison of the satellite images of two

different years (2006 and 2017, please refer to Section 3.3.3).

Table 3.2.7 shows the annual population growth, population density and features of communes in Kinshasa City.

Table 3.2.7 Available Sources and Statistical Population by Commune of Kinshasa City

Commune and categories	Average annual growth rate of population (%/year) 2004-2013	Population density (p./km2) 2013	Characteristics of communes from the statistical result, Issues to be confirmed
Residential Area			
Gombe	9.0	5,735	The Population is doubled in recent 10 years. It is necessary to confirm if there is a possibility of 30,000 persons increase and corresponding developments have taken place.
Limete	1.7	15,328	The growth rate of population and the development speed of urbanization are low
Ngaliema	4.1	15,286	Population growth is observed to follow urbanization. The population growth rate is the average of the urbanized areas of Kinshasa
Old City			
Kintambo	4.1	38,777	It seems that not so much available areas existed in 2004. It is necessary to confirm the reality of the corresponding population increase without expansion of residential areas in the limited space.
Barumbu	1.1	37,304	One fifth of the land of the commune is used for the Ndolo Airport. The actual population density is estimated about 450/ha.
Kinshasa	-0.8	49,436	It is necessary to find reasons of population decrease. Considering that there are large scale land of stadium and museums in the commune, it is necessary to confirm the possibility of population density.
Lingwala	3.5	46,941	There are large scale land of military facilities, governmental facilities, and public facilities in the commune. It is necessary to confirm the possibility of population density considering about this situation.
New City			
Ngiri-ngiri	-0.5	57,261	Mostly no changes during the period 2004-2013.
Kasa-vubu	-3.5	29,751	The result shows certain decrease of population. It is necessary to identify the reasons for the change.
Planned City			
Kalamu	-1.0	48,093	Mostly no changes during the period 2004-2013.
Lemba	2.8	31,122	As a large area is occupied by the campus of Kinshasa University, the population density of actual urban area is higher than the statistics.
Matete	2.3	68,740	It is necessary to evaluate the possibility of progress of residential development made higher population density of the area. It is necessary to confirm the correspondence of population density and current urban situation.
Bandalungwa	5.3	45,829	Most of the commune is occupied by military facilities. It is necessary to confirm military areas situation (esp. counting of population) and boundary of the commune.

Commune and categories	Average annual growth rate of population (%/year) 2004-2013	Population density (p./km2) 2013	Characteristics of communes from the statistical result, Issues to be confirmed
N'djili	3.0	61,954	The population density of the commune is relatively high. It is necessary to confirm the situation of the current living environment of the area.
Southern Suburbs			
Ngaba	4.0	90,340	The result shows high population density and its densification, even if there is not much area to be developed. It is necessary to confirm and evaluate their possibility.
Selembao	2.5	21,229	A rapid population growth is observed especially in the newly developed residential area on the hilly land in the south of the commune. Population will grow as the natural increase.
Bumbu	5.6	117,962	The result shows high population density and its densification, even if there is not much area to be developed. It is necessary to confirm and evaluate their possibility.
Makala	2.0	59,079	The population density is over 500/ha, while the growth rate has dropped lower than the rate of natural increase in recent years. Due to the overpopulation, the population increase is thought to be saturated.
Urban Periphery			
Kisenso	3.2	33,071	No available land exists for residential development. Besides, land for newly built residential area is also limited. The increase of population is thought to continue only corresponding to the natural increase, with the density coming up to about 400/ha.
Masina	7.1	19,720	The population density is still low, although the population of the commune had been increased much. It is necessary to confirm the possibility of expansion of urban space toward the bank of the Congo River.
Kimbanseke	4.5	21,329	Residential development is progressing on the sloping land, farmland, green land and forestland in the south of the commune. Urbanized residential development is progressing in the north of the commune.
Mont-ngafula	7.2	1,069	Residential development is progressing on the farmland of hilly area, green land and forestland in the south of the commune. The population is estimated to over that of Ngaliema commune in 2017 according to the satellite image.
N'sele	15.8	553	Farmland and green land in the lowland alongside the Lumumba Boulevard in the north of the commune is now continuing to change to residential area, and the residential development is proceeding. The population growth due to natural increase and external inflow is considered to continue..
Maluku	19.2	98	The Study confirmed conditions within the Study area, which consists of the industrial and portal area near the Congo River.

Source: The Study Team

b) Estimation of Recent Population Growth Rate (2013 to 2017)

According to the analytical results of spatial conditions and their changes by commune, the Study elaborated the recent annual population growth between 2013 and 2017 for each commune. Its basic idea is as follows:

- Commune of little growth or decrease:
  Some communes which are located in North West Kinshasa City, are already occupied and their population density have been reached to 500 people/ha or more. For these communes, most of their areas had been urbanized and developed, and there remain mostly no areas to be urbanized. The Study assumes a lower growth rate for these communes.
- Commune of continuous growth:
  Even near the central area of Kinshasa City, there are communes which have available land for future development. For example, Gombe Commune has a possibility to increase its population by redevelopment of the urban space. Also, Ngaliema Commune has available land for development in the commune. For these communes the Study set mostly equivalent to the rate of 2004 to 2013 for their increase rate.
- Commune of high growth:
  In recent years, large scale developments have been observed in periphery areas of Kinshasa City. In these communes, high population increase was recorded and their average increase rates reach 7% or more. The population densities of these communes are still low and these communes have a lot of non-cultivated land. The Study considers continuous urbanisation trends in these communes and set a high growth rate for their population growth.

Based on the verification of spatial conditions and land use changes of communes, the Study estimated the preliminary population by commune in 2017 and the agglomeration for the total population in Kinshasa City.

This preliminary estimate of total Kinshasa City population resulted in 12,358,084 persons and which was found very close to the UN based-estimate of low variant, i.e. 12,505,000 persons as indicated in Table 3.2.8.

It is therefore concluded that the total Kinshasa City population in 2017 should be set as 12,505,000 persons and the preliminary population by commune should be adjusted accordingly as presented in Table 3.2.8.

Table 3.2.8 Estimated Population by Commune in Kinshasa City, 2017

Group of Commune	Name of Commune	Surface (km2)	Population (2013)	Estimated Population Growth 2013 to 2017	Estimated Population (2017)	Estimated Population Density (2017) (persons/ha)
Residential Area	Gombe	12.31	70,594	3.40%	80,696	65.55
	Limete	28.43	435,720	1.70%	466,113	163.95
	Ngaliema	63.94	977,485	4.10%	1,147,924	179.53
Old City	Kintambo	3.94	152,918	4.10%	179,581	455.79
	Barumbu	4.44	165,720	1.00%	172,449	388.40
	Kinshasa	3.09	152,778	0.00%	152,778	494.43
	Lingwala	2.76	129,439	3.50%	148,534	538.17
New City	Ngiri-ngiri	2.92	167,019	0.00%	167,019	571.98
	Kasa-vubu	3.84	114,152	0.00%	114,152	297.27
Planned City	Kalamu	5.97	287,045	0.00%	287,045	480.81
	Lemba	14.44	449,429	3.00%	505,836	350.30
	Matete	4.80	330,177	1.00%	343,584	715.80
	Bandalungwa	7.03	322,313	3.00%	362,766	516.03
	N'djili	9.37	578,411	3.00%	651,007	694.78
Southern Suburbs	Ngaba	2.86	258,057	2.00%	279,329	976.67
	Selembao	19.73	418,925	3.00%	471,504	238.98
	Bumbu	4.54	536,018	0.00%	536,018	1,180.66
	Makala	5.16	304,615	2.00%	329,725	639.00
Urban Periphery	Kisenso	15.56	514,565	3.00%	579,147	372.20
	Masina	45.54	897,980	4.50%	1,070,858	235.15
	Kimbanseke	65.99	1,407,437	4.50%	1,678,395	254.34
	Mont-ngafula	456.36	487,722	10.00%	714,074	15.65
	N'sele	953.30	527,305	10.00%	772,027	8.10
	Maluku	8,930.83	872,175	10.37%	1,294,439	1.45
Total		**10,667.14**	**10,557,999**	**4.32%**	**12,505,000**	**11.72**

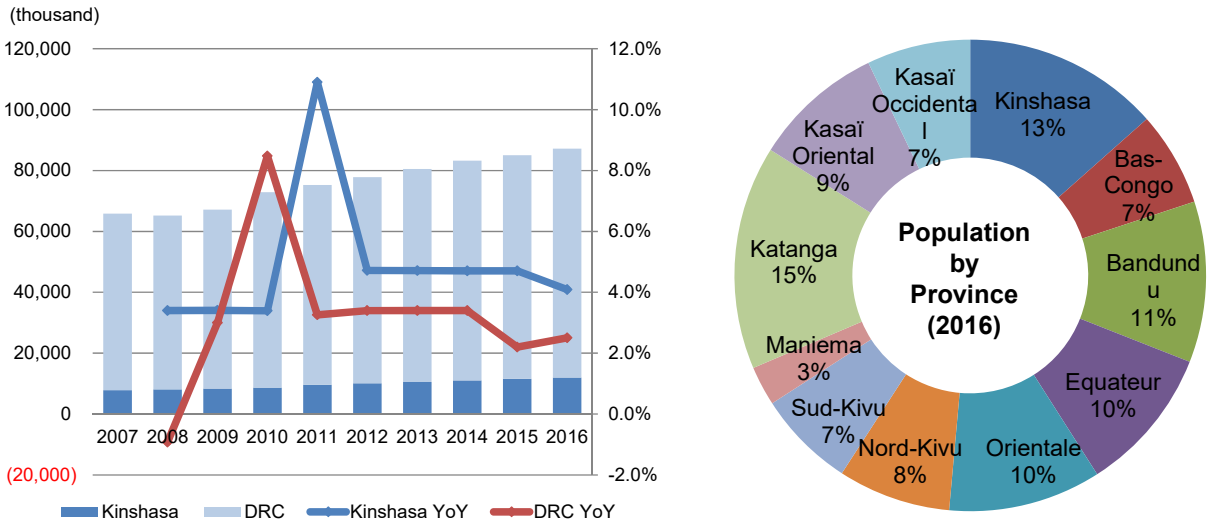
Source: The Study Team

3.2.2 Current Economic Development

(1) Current Whole Population in DRC

According to the statistics data by the INS, the population of DRC was recorded as 87 million in 2016 with the CAGR (Compound Annual Growth Rate) of 3.2% from 2007 to 2016, and the population of Kinshasa City was 12 million with the CAGR of 4.9% during the same period. The population growth rate of Kinshasa City is higher than the nationwide rate.

By dividing the total population into provinces, the population of Kinshasa City constituted 13% in 2016. The most populated province is Katanga, constituting 15% of the total population.



Source: INS

Figure 3.2.3 Population of DRC and Kinshasa City

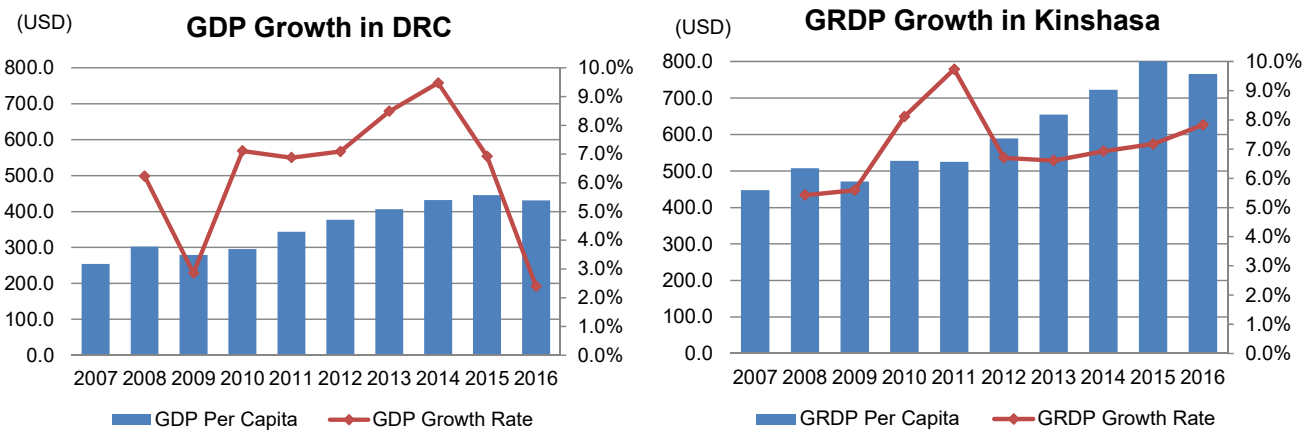
(2) Current Economic Development

1) GDP/GRDP

The DRC has achieved high economic growth for the past ten years driven mainly by the mining, transport and telecommunication sectors. The average real Gross Domestic Product (GDP) growth rates between 2007-2016 were recorded at 6.4% and the GDP per capita was USD 430.9 in 2016. Despite the average high growth, the real GDP growth rate contracted from 6.9% in 2015 to 2.4% in 2016 due to the deterioration of the international commodity prices. The slowdown of the economic growth caused the decline in exports and reduction of the national income. However, with the anticipated rise in the country's raw material prices, the economy is expected to rise again by 4.0% in 2017 onwards.

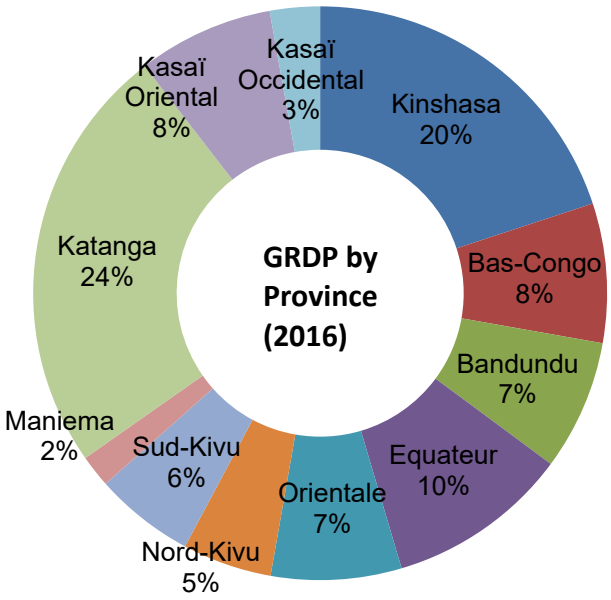
In Kinshasa City, the average real GRDP (Gross Regional Domestic Product) growth rates between 2007 and 2016 recorded 7.1%, driven mainly by transport and telecommunication sector, the growth rate is higher than the national average. The GRDP per capita of Kinshasa was USD 766.2 in 2016.

By classifying the GDP into provinces, the graph shows that the three provinces provide 55% of the national wealth: Katanga (24%), Kinshasa (20%) and Ecuador (10%), which shows the significant socio-economic inequalities among provinces.



Source: INS

Figure 3.2.4 GDP Growth of the DRC and Kinshasa City (2007-2016)



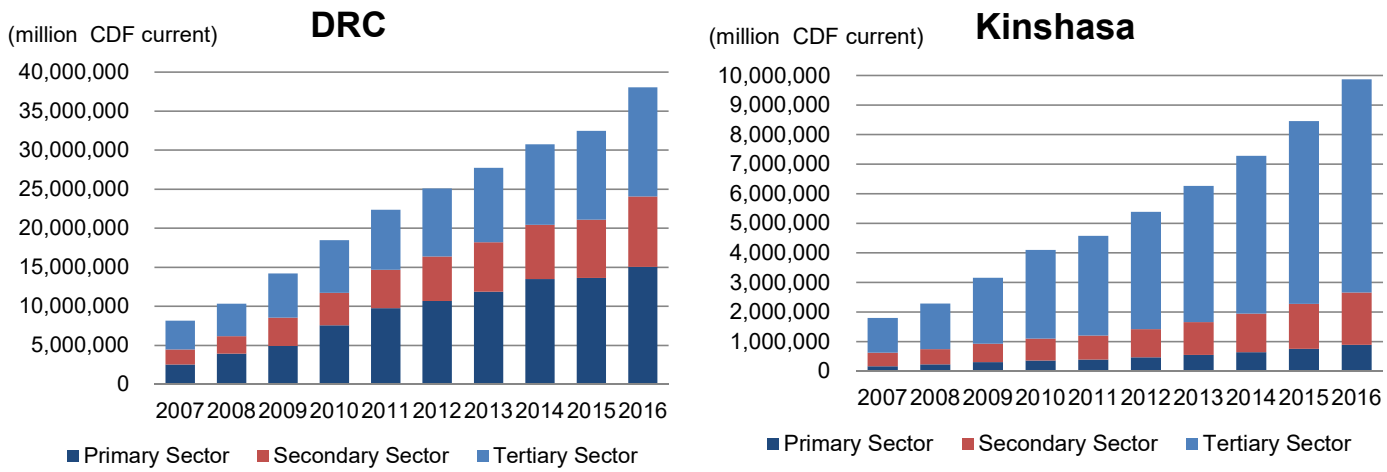
Source: INS

Figure 3.2.5 GRDP by Province (2016)

2) GDP/GRDP by Sector

In the GDP composition by sector, the economy is composed by the primary sector for about 40%, the secondary sector for about 20% and the tertiary sector for about 40%. The main drivers of growth have been trade, transport and telecommunication, and extraction mainly mining.

In Kinshasa City, the tertiary sector is the main source of growth which contributes about 70% of the total GRDP, mainly driven by the transport and telecommunications through the improvement of ways and means of communication.



Source: INS

Figure 3.2.6 GDP by Sectors (2007-2016)

Table 3.2.9 GDP by Sector in 2016

2016	DRC	Kinshasa
Primary Sector	**39.6%**	**8.9%**
Agriculture, etc.	20.5%	8.5%
Agriculture	19.8%	8.2%
Forestry	0.7%	0.3%
Breeding, Hunting, Fishing	0.0%	0.0%
Extraction	19.1%	0.4%
Secondary Sector	**23.7%**	**17.7%**
Manufacturing	20.2%	14.9%
Food, beverage and tabacco industry	17.5%	13.4%
Other manufacturing	2.7%	1.5%
Construction and public works	0.9%	1.0%
Electricity, gas, steam and water	2.6%	1.8%
Tertiary Sector	**37.5%**	**72.0%**
Trade, Transport and Telecommunications	23.6%	50.4%
Other services	8.0%	3.6%
Public administration services	5.9%	18.1%
FISIM	-0.8%	1.4%
TOTAL	**100.0%**	**100.0%**

Source: INS

3) Economic Indicators of 2017

Based on the growth trends and estimations by INS, the economic indicators of 2017 are shown in Table 3.2.10.

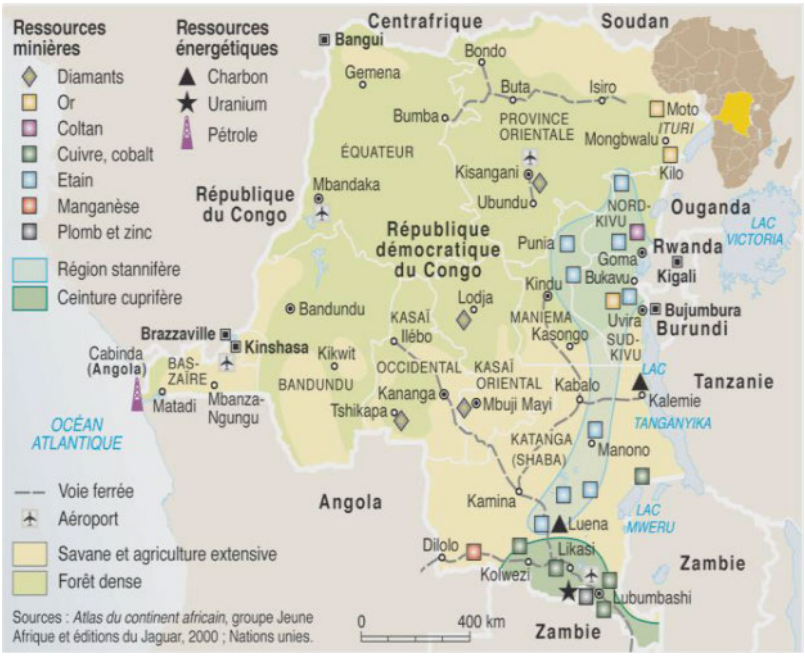
Table 3.2.10 Economic Indicators of 2017

Indicators		Figure	Source
Population	DRC	89,941 thousand	The growth rate of 3.2% from the previous year, based on the estimation by INS
	Kinshasa City	12,505 thousand	The growth rate of 3.94% from the year 2015, based on the estimation by INS, UN and the Study Team
Employment	DRC	29,240 thousand	The growth rate of 3.2%, projection by ILO has been applied at the numbers of 2012
	Kinshasa City	2,678 thousand	
GDP Growth Rate	DRC	4.0%	INS
	Kinshasa City	9.1%	INS
GDP per Capita	DRC	477.4 USD	INS
	Kinshasa City	850.1 USD	INS

Source: The Study Team

4) Mining Sector

The contribution of the mining sector to the economy is significant. More than 1,100 different minerals are available such as copper, cobalt, gold, silver, nickel, coltan, tin, iron, and zinc. The DRC has 7.2% of world's cobalt reserves, 27.3% of the world's diamond reserves, and 80% of coltan reserves. Most of the minerals are extracted in the southeastern and northeastern side of DRC.



Source: PNSD

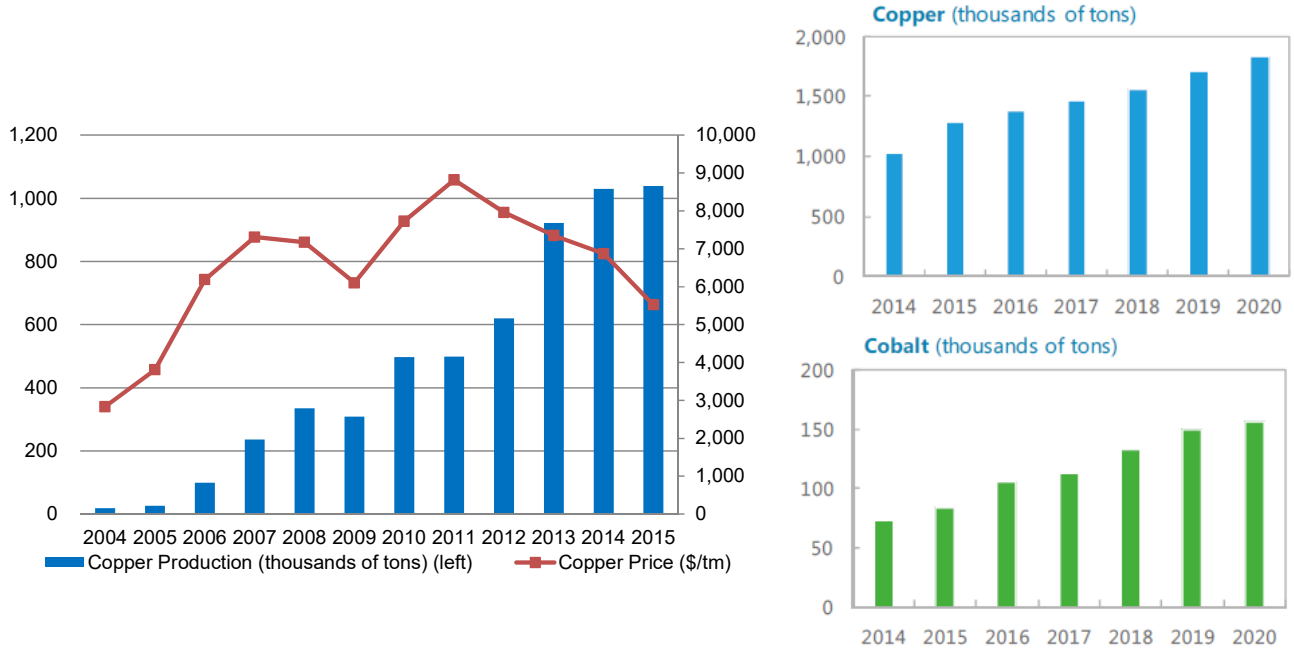
Figure 3.2.7 Major Mining Products and the Locations

However, the strong dependence on the mining sector exposes the economy to the potential risks

of economic downturn internationally. The declines in world commodity prices recorded in 2009 and 2014 had a significant impact on the sector's contribution to the growth and the development of socio-economic situation. The price of copper traded on the London market averaged USD5,500/t in 2015 and USD4,800/t in 2016, and recovered to USD5,600/t as of June 2017.

The copper contributed about 65% of the country's export earnings, therefore, decline in copper prices cause great impact to the economy. The production volume of copper and cobalt will be sustained up to 2020, the risks of the dependence to the mining sector need to be notified.

It should also be noted that the mineral resources are not processed domestically and exported to overseas. The new investments which do not limit to extraction but to include the processing of raw materials into semi-finished products and finished products in the country are expected to be attracted to the country.



Source: BCC (Banque Centrale du Congo / Central Bank of the Congo) and IMF (International Monetary Fund)

Figure 3.2.8 The Trends of Copper Prices and Production Estimates

5) Industrialization of the Survey Area

The trends of the number of registered companies in the Survey Area have been analysed based on the annual report of FEC (*Fédération des Entreprises du Congo* / Federation of Congolese Enterprises) in 2009 and 2017. The data shows that the number of registered companies increased from 298 to 745 during the mentioned period, with the CAGR of 12.5%.

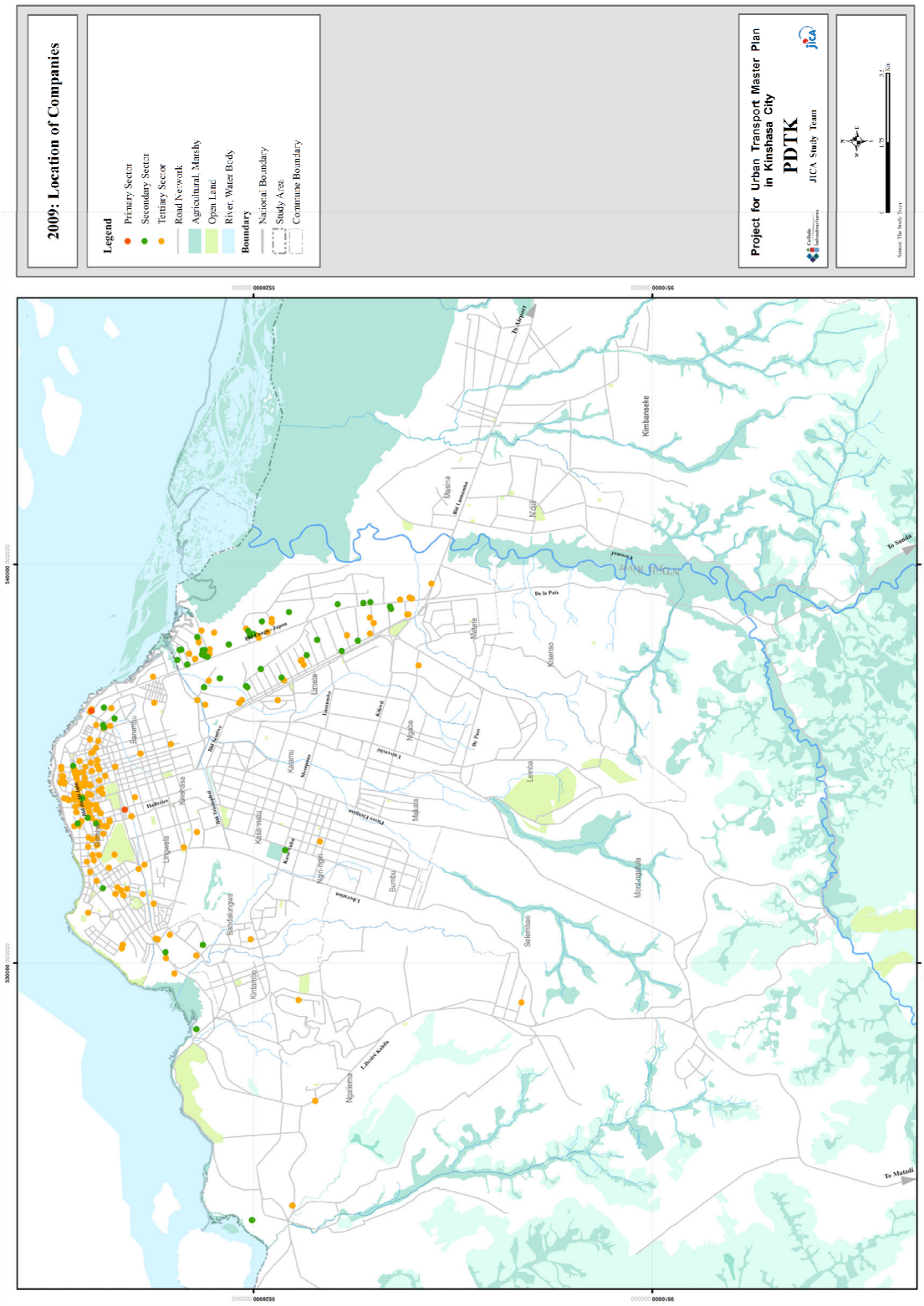
The companies have been divided by the sectors and communes as shown in Table 3.2.11. In terms of sector, the tertiary sector has the biggest share of 73% in 2009 and 80% in 2017 which is in line with the GRDP composition. The service sector includes Finance and Banking, Mines (service office), Services, Telecommunication, Transport, Commerce, Energy and Hydrocarbons (Service Office) and others, and the location is concentrated at the Gombe Commune. The share of the secondary sector composed by Industries and Construction were 24% in 2007 and 15% in 2017. The Industrial companies are concentrated in the Limete Commune, and their manufacturing goods are pharmaceutical, plastic, printing, brewery, and textile etc. Ngaliema Commune also has several industrial companies for producing bottles, ships, construction materials, flour mills and plastic. The share of the primary sector composed by agriculture, livestock and fishing was 3.4% in 2009 and 5.9% in 2017. The companies are located in the Communes of Gombe, Limete, Ngaliema and Maluku.

Table 3.2.11 The Number of Companies by Sector and Commune

Sector	2009	2017
Primary Sector	10	44
Agriculture, Livestock & Fishing	10	44
Secondary Sector	72	109
Industries	50	62
Construction	22	47
Tertiary Sector	216	592
Finance and Banking	23	59
Mines (Service Office)	18	15
Services	43	193
Telecommunication	8	22
Transport	20	57
Commerce	84	186
Energy and Hydrocarbons (Service Office)	2	58
Others	18	2
Total	298	745

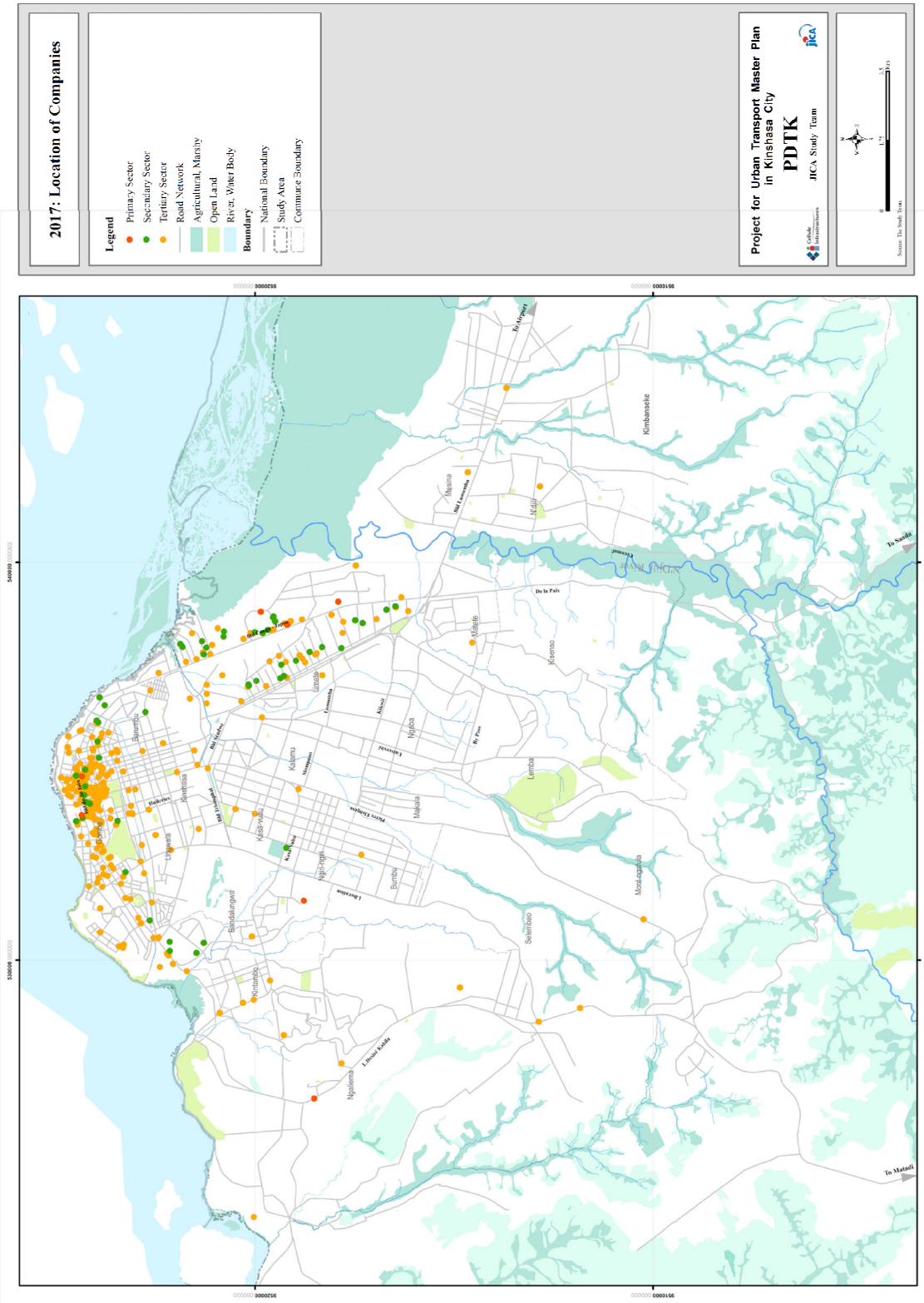
Commune	2009	2017
Gombe	174	443
Limete	63	122
Ngaliema	12	36
Kinshasa	13	25
Barumbu	11	8
Lingwala	1	13
Kasa-Vulu	2	13
Others	22	85
Total	298	745

Source: FEC (Federation of Enterprises)



Source: The Study Team

Figure 3.2.9 Locations of Companies in Kinshasa City (2009)



Source: The Study Team

Figure 3.2.10 Locations of Companies in Kinshasa City (2017)

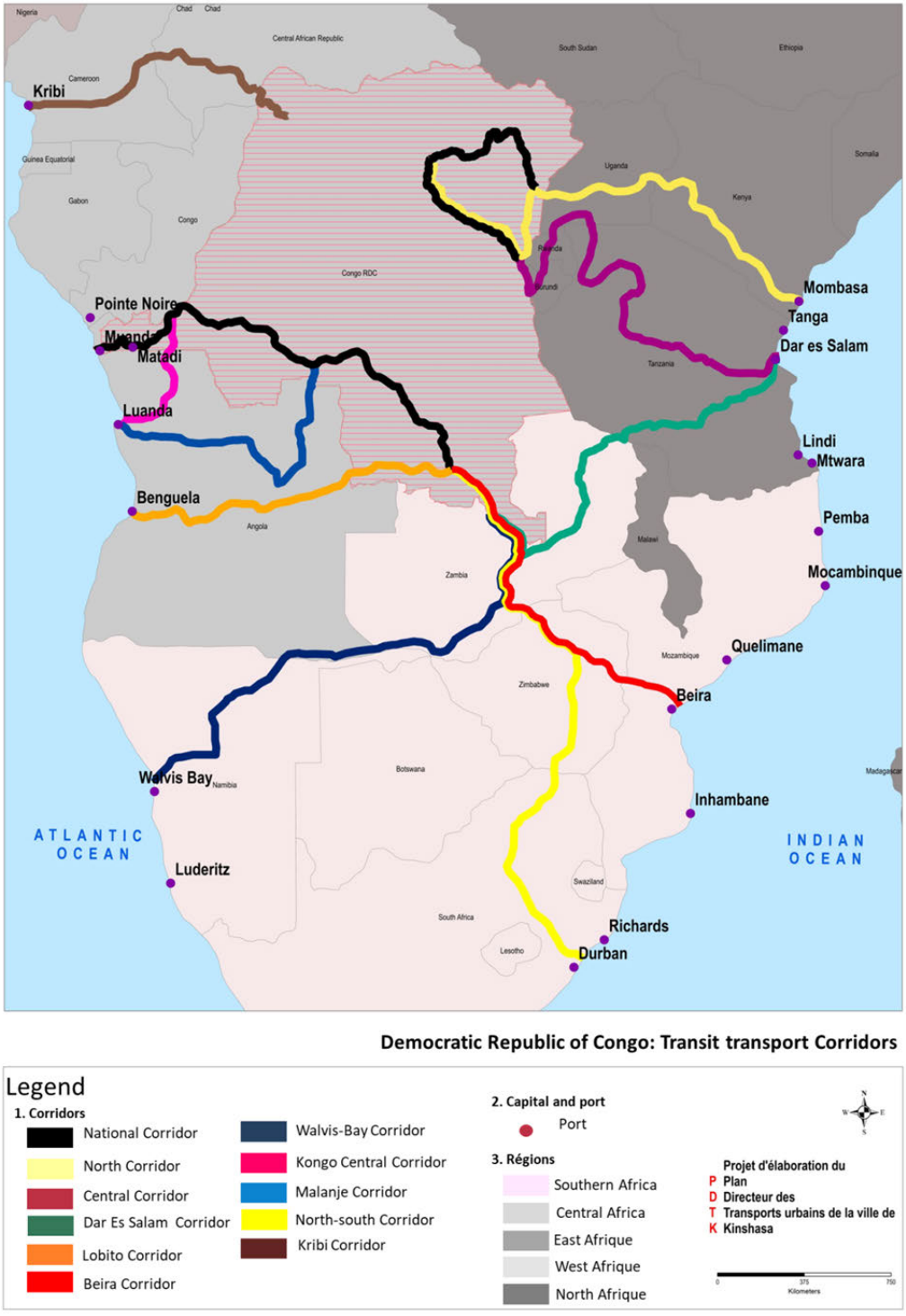
6) Economic Corridors

To facilitate the trade flows in the region, the eleven economic corridors have been identified connecting with Central Africa, Southern Africa and a part of East Africa. These corridors are a part of a long-term approach to facilitate international trade as well as the development of countries in the region. In DRC, the CEPCOR *(Cellule d'Appui et de Suivi des Projets Intégrateurs et des Activités des Corridors des Transports* / Unit for the Support and Monitoring of Regional Programs and Activities of Transport Corridors), an organization under the Ministry of Transport and Communication, is in charge of promoting regional corridors for utilizing the strategic location of DRC. Table 3.2.12 lists all the regional corridors and their locations are exhibited in Table 3.2.11.

Table 3.2.12 Features of Economic Corridors

Corridor	Route	Features
1. National Corridor	Banana-Kinshasa (about 400km) by road/rail, Kinshasa-Ilebo (about 800km) by river, Ilebo-Lubumbashi (about 1,500km) by rail	The historical corridor and the route to connect with the Atlantic Ocean
2. North Corridor	Mombasa-Kisangani (2,466km) by road	The corridor passing through Kenya, Uganda, and/or Burundi and DRC
3. Central Corridor	Dar es Salaam-Bujumbura-Bukavu (1,539km) by road/Dar es Salaam-Kigoma (1,254km) by rail and Kigoma-Kalemie by river	The corridor is a set of multimodal transport routes (rail, road, river and lake) linking Tanzania, Burundi, DRC, Uganda and Rwanda. It is integrated by a treaty under SADC (South African Development Community).
4. Dar es Salaam Corridor	Dar es Salaam-Kigoma (1,254km) by rail, Kigoma-Lubumbashi (913km) by road	The corridor connects Tanzania, Malawi, DRC and Zambia through rail and road network.
5. Lobito Corridor	Lobito-Lubumbashi-Mapiri Mpochi (2,304km/2,156km) by rail/road	The corridor connects to the port of Lobito in Angola through Zambia and DRC. The Angolan railway was rehabilitated in 2015.
6. Beira Corridor	Beira-Lusaka-Lubumbashi by rail/road (2,652km/1,593km)	The corridor connects to the port of Beira in Zimbabwe through Zambia and DRC.
7. Walvis Bay Corridor	Walvis Bay-Lusaka-Lubumbashi (2,600km) by rail/road	The corridor connects to the port of Walvis Bay in Namibia through Zambia and DRC.
8. Bas Congo Corridor	Kinshasa-Lufu-Luanda (1,060km) by road	The multimodal corridor linking Kinshasa City, Bas Congo and the Luanda Port in Angola
9. Malanje Corridor	Luanda-Kananga (1,137km) by road	The corridor links the Southwestern provinces of DRC and the Port of Luanda
10. North South Corridor	Durban-Lusaka-Lubumbashi by road/rail (2,933km/3,276km)	The longest corridor in Southern Africa linking South Africa, Zimbabwe, Zambia and DRC. The treaties have been made in COMESA and SADC.
11. Kribi Corridor	Kribi-Akula (2,050km) by road	The corridor connects to the Cameroon port of Kribi with DRC.

Source: CEPCO



Source: CEPCO

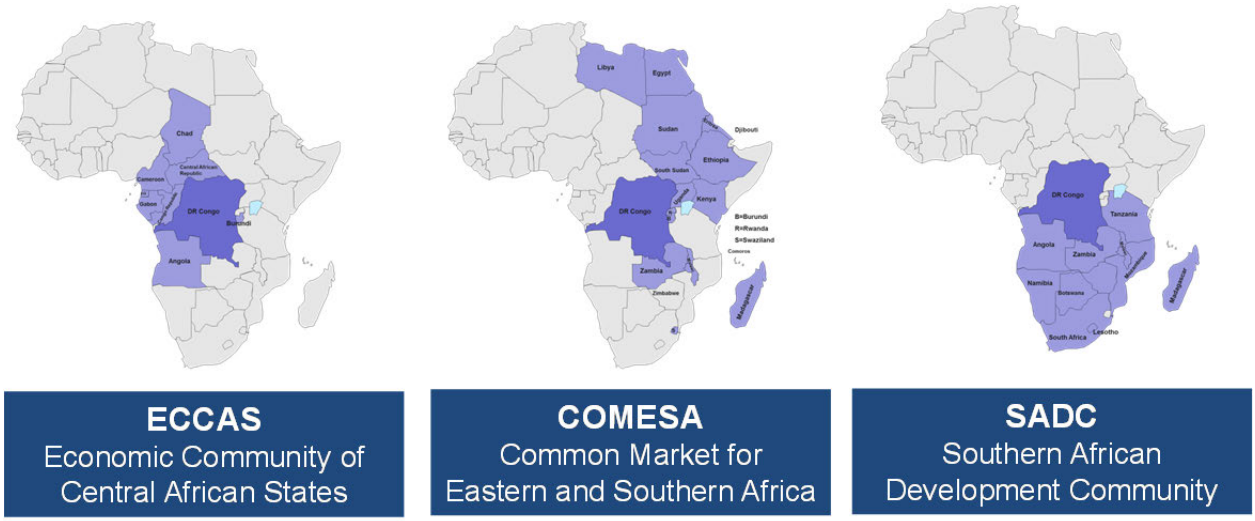
Figure 3.2.11 Map of 11 Corridors

7) REC (Regional Economic Community)

The country's exports are dominated by raw materials, almost 100% of total exports and imports of consumer and capital goods, 94% of total imports. The DRC intends to take advantage of its geographical advantages with nine land borders connected with several community spaces. Studies have shown that the reduction of tariff and non-tariff barriers between member countries will promote trade relations and growth.

Although the DRC is active in the regional cooperation organizations such as ECCAS (Economic Community of Central African States), COMESA (Common Market for Eastern and Southern Africa), and SADC (Southern African Development Community), the performance of businesses over the border are relatively low. Several factors remain such as lack of integrated infrastructure and lack of common policy.

Given the highly strategic geographical position of the country, the integration will lead the integrated market, development of SMEs (Small and Medium-sized Enterprises), increase middle class, strengthen PPP (*Partenariat Public Privé*/Public-Private Partnership) and formulate the formal economy.



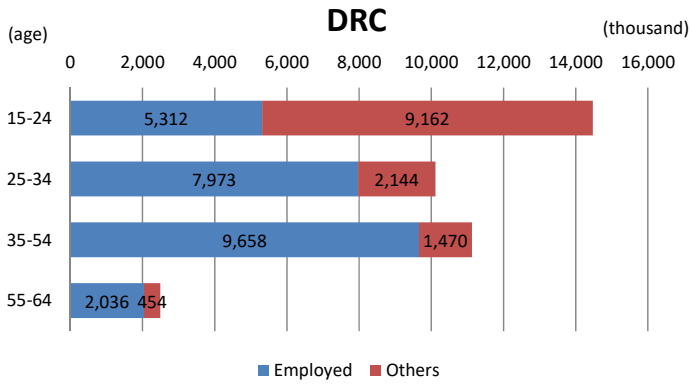
Source: The Study Team

Figure 3.2.12 Economic Community for DRC

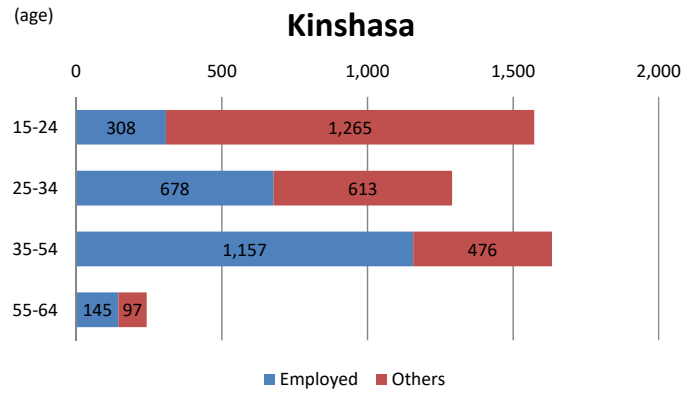
3.2.3 Employment

(1) Number of Employment

Despite the high economic growth performance, the DRC remains facing a serious problem of job creation. Only a small proportion of people of working age have paid work, and many people have few opportunities to train for the skills and know-how required in the market. In addition, the shortage of workers with appropriate professional qualifications affects productivity and hampers the development of the economy.



DRC (2012, thousand)	
Population Ages 15-64	38,208
(Employed)	24,979 (65%)
(Others)	13,230 (35%)



Kinshasa City (2012, thousand)	
Population Ages 15-64	4,739
(Employed)	2,288 (48%)
(Others)	2,451 (52%)

Source: INS

Figure 3.2.13 Number of Employment in DRC and Kinshasa City

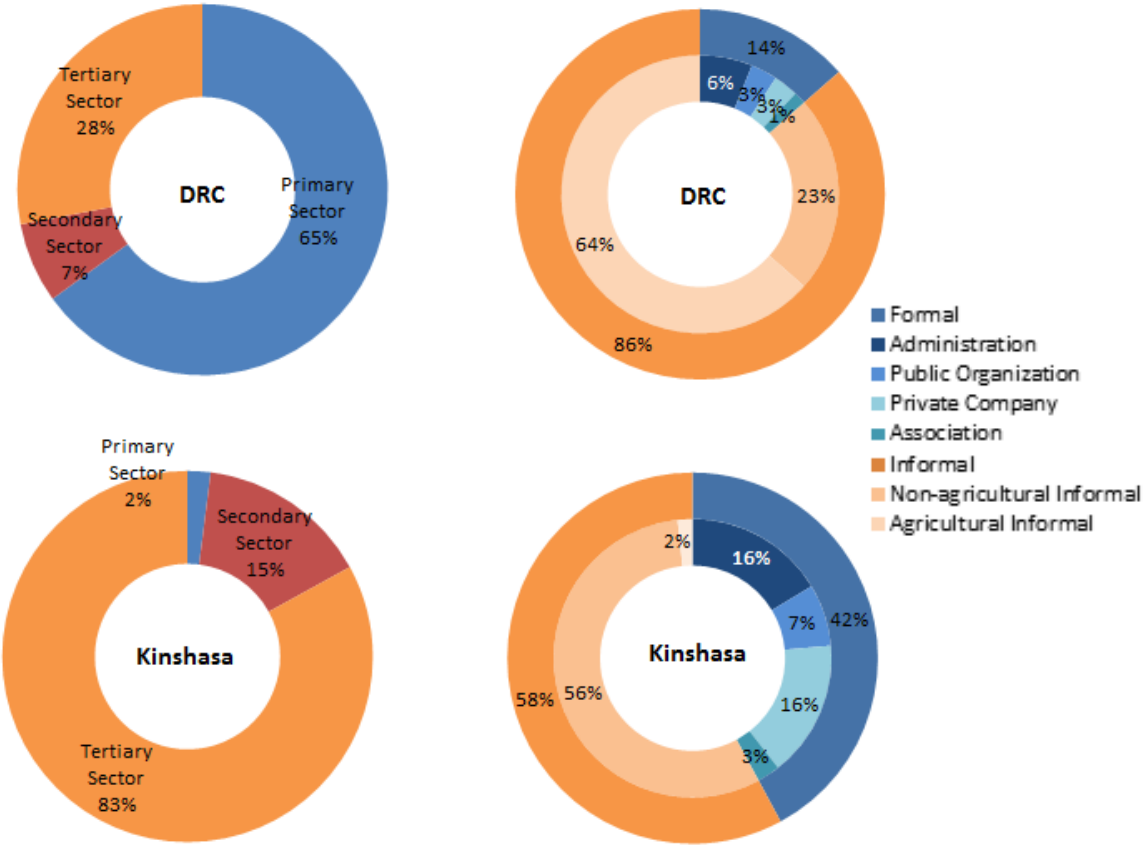
Figure 3.2.13 shows that in the DRC in 2012, according to the survey by INS, out of the total population ages 15-64 of 38.2 million, 65% are employed and 35% are others including unemployed, housewives and students, etc. In Kinshasa City in 2012, out of the total population ages 15-64 of 4.7 million, 48% are employed and 52% are others. Kinshasa City records show a lower employed ratio than DRC, and this is assumed to be due to the higher education enrolment in Kinshasa City ages 15-24.

(2) Employment by Industry and Formal/Informal Structure

By classifying the employment by industry, in DRC, agriculture is the main economic activity in rural areas, occupying about 65% of the working population. In DRC, the informal sector occupies 86% of the total employment, of which 23% as non-agriculture informal and 63% as agriculture informal.

In Kinshasa City, tertiary sector occupies 83% of the total employment, with 2% of primary and 15% of secondary.

Divided by the type of organization, about 58% of the employment is working in the informal sector including non-agriculture and agriculture, and about 42% of the employment is working for the formal sector.



Source: INS

Figure 3.2.14 Employment by Industry and Formal/Informal Structure

3.3 Existing Land Use and Urbanisation of the Study Area

3.3.1 Existing Land Use

In this section, the Study deals with the current land use of the Study Area and analyses its composition and structure.

(1) Process to Prepare Existing Land Use Map

a) Data Sources Available for Land Use Analysis

For the preparation of current land use drawing, the study referred to the following materials.

- Satellite photo of the Study Area (2014-2017): It is mostly used for identifying the urbanized area and large scale building sites.
- Result of building use survey conducted by the Study for the central six communes: A field survey for identifying building condition and building use.
- Result of site visit observation
- Land use map by SOSAK as reference
- Other published street maps for commercial use

b) Process of Identification of Land Use

Referring to the above mentioned materials, the Study prepared a land use map of the Study Area by the following process.

- Division of rough land use

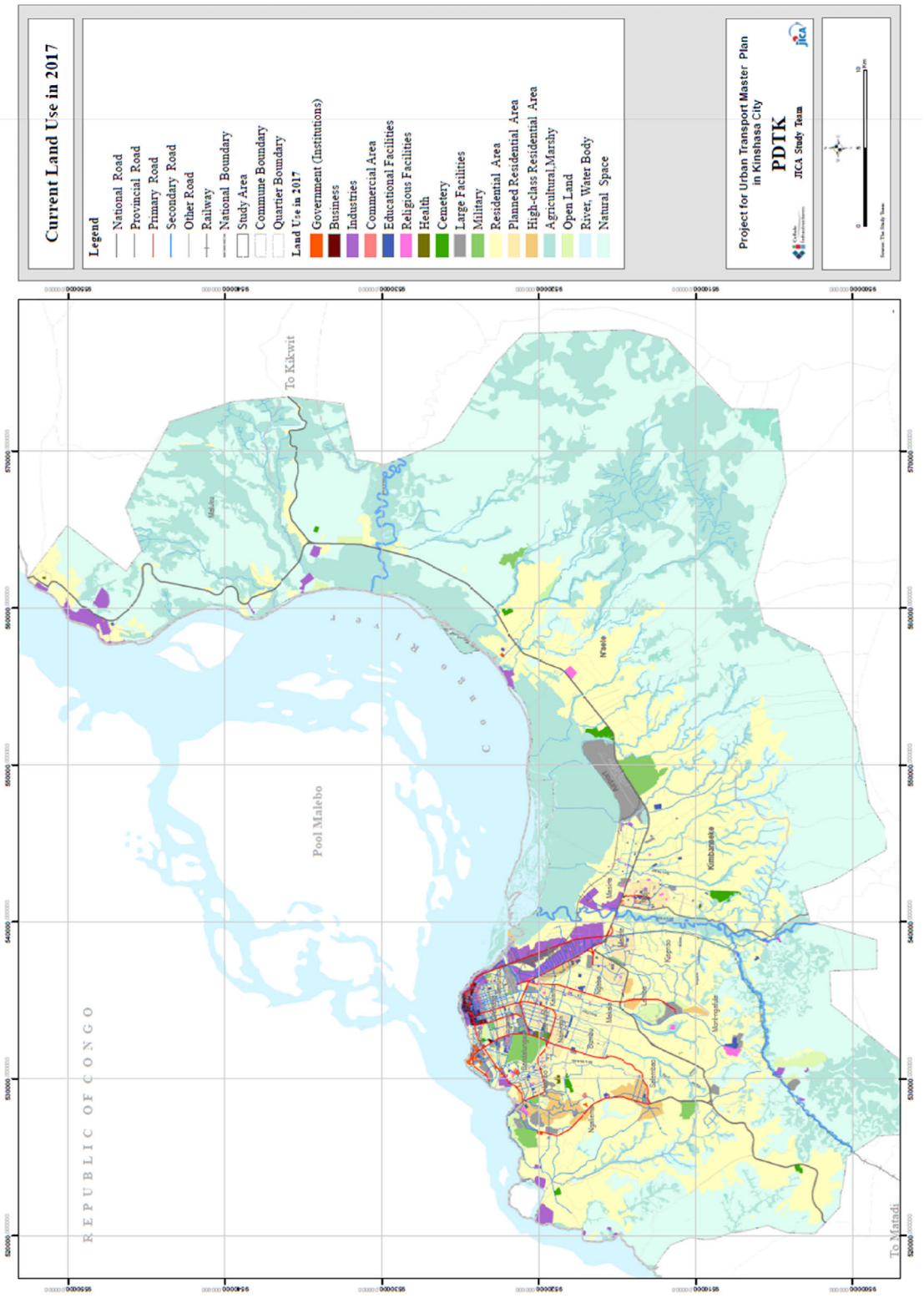
  Referring to the satellite image, urbanised areas, water areas, marsh areas, and agricultural fields are roughly identified.

- Large scale facilities

  Large scale facilities (such as airports, stadiums and public markets) are distinguished referring to the satellite images, published maps and are classified according to identified functions.

- Detailed land use

  Referring to the above mentioned large scale facilities and sites, details of land use are assured by site visit confirmation and confirmation of information on web mapping pages. The results of the detailed survey for the central areas are reflected for the preparation of land use mapping.



Source: The Study Team

Figure 3.3.1 Existing Land Use of the Study Area in 2017

(2) Analysis of Land Use of the Study Area

a) General Aspect of Land Use

Despite historical efforts to restructure the urban spaces of Kinshasa, the urban space of Kinshasa shows a mono pole structure. There are the sole strong commercial and business centre in Gombe, and the industrial agglomeration in Limete.

In its long history, in order to avoid over-concentration in the centre of the city, several plans were proposed as the solution. But these plans have not been implemented as planned, and the urban space was expanded with mixture of a residence, commercial, business and industrial land use and building use.

The followings descriptions explains the basic distribution of land use of Kinshasa,

b) Residential Area

- Detached Housing

  Excluding some exceptions in central areas, most of the detached houses in Kinshasa are constructed as low-rise buildings. The size of the housing and building qualities differ by communes, which is supposed to be related with developed ages and income level of migrant people.

  Recently, developed housing in the peripheral areas were constructed in a large housing lot, which accepted moving of families from congested areas of the centre of the city.

  In other areas, especially in unplanned development areas, the size of housing and their lots are mostly small.

- Apartments

  High-rise apartment buildings are located in the central area, Gombe Commune and Limete Commune. But they are seldom observed in other communes except for special purpose buildings such as residences in military areas.

  In recent years, the conversions of former detached housing to be reconstructed to apartment type buildings with three to four floors are observed in certain communes. Some of these houses are considered to be used as apartment buildings.

- Mixed Use Buildings

  Many buildings of Kinshasa, regardless of its size, number of floors, and qualities, are mixed use buildings.

  Many detached house buildings have small shops or handicraft space in the housing lots and their actual situation is unclear. For this reason, it is difficult to define current land use zone clearly in the map.

- Barracks

  From the result of the land use change analysis (ref.3.3.3), construction and increase of barracks are observed especially in public facilities' land such as military camps and open space of river banks. The actual situation of these areas is not known.

c) Administrative Area, Business Area

Most of administrative buildings of national and provincial levels, and business buildings are located in Gombe Commune. Also, some are located in Limete Commune, where plots for industrial facilities are used for business service function.

Large scale public facilities are constructed in Lingwala, Kinshasa, Barumbu, and Kasa-vubu Communes, along the Triomphal Boulevard.

Many small and business buildings are considered for location in mixed use buildings in every commune.

d) Commercial Area

- Commercial Market

  In Kinshasa, the provincial government provides public markets.

- Large Scale Commercial Housing

  Large scale shopping centres, supermarket buildings, and commercial complex buildings are observed in Gombe Commune and its surroundings. But they are seldom observed in other communes.

- Other Commercial Facilities

  Accumulation of small scale commercial facilities, most of which are mixed use buildings, are observed every place in the Study Area.

  Along the arterial roads, there are market places with of commercial facilities with logistic and wholesaling functions. These places are observed along N1 in Mont-ngafula and N'sele Communes.

e) Industrial Area

- Industrial Area of Limete Commune

  Limete Commune was initially planned with its industrial area, and it is the only planned industrial area in Kinshasa. Its plots are prepared for productive factories, but some of them are used for commercial facilities, business offices and housing these days.

  The working capacity of the area is unknown because of the lack of statistics and other referential documents.

- Industrial area Northern along Congo River

  In addition to above mentioned industrial area in Limete Commune, some industrial facilities and factories are located near the central area in following communes.

  - Kintanbo Commune: there were large scale textile factories and related factories. Most of them have abandoned its productive activities and its characteristics of industry are not particular in these days.
  - Port of Kinshasa: Part of wood processing is done in the wharf area of Port of Kinshasa.
  - Industrial area in Kinkole

A river port was constructed in Kinkole along Congo River, in N'sele Commune. In its hinterland, several industrial facilities and factories are constructed.

- Industrial area in Maluku

  There was an iron manufacturing factory in Maluku but it has abandoned its operation. Also a shipbuilding factory as a related industry was abandoned as well.

  There are SEZ planned areas in Maluku and the landing is under progress. But specific land use and its information have not been confirmed until now.

f) Small Workshops

Small workshops are observed as part of mixed use buildings every place in the Study Area. Some are accumulated in limited areas and generate characteristic industrial chains. For example, car repairing workshops are accumulated in N'djili Commune and have formed specific areas of a used car industry.

g) Logistics Area

- Port of Kinshasa

  Port of Kinshasa is the principle river port which bears international trade and domestic cargo traffic with large scale vessels.

- Port of Maluku

  Port of Maluku is located about 50km away from the centre of Kinshasa and bears domestic passenger transport with small scale vessels.

- Port of Kinkole

  Port of Kinkole can accept medium scale vessels and barges for domestic cargo transport. According to the geographical situation, it can be a sub port of Kinshasa.

- Other Ports of Kinshasa

  Along a small creek near the Marina of Kinshasa, there is a pool for barges and wooden vessels. They bear domestic cargo transport but their operation is considered as informal and their facility and equipment are mostly nothing and in a quite bad situation.

- Railway Station of Kinshasa

  There is a central station for passengers, and cargo terminals in the wharf of Kinshasa Port and Triage Station in Limete Commune. The current function of Triage Station is not confirmed.

- Railway Station of Kasangulu

  Kasangulu City, which is located in Congo Central Province, has a railway station on Kinshasa -Matadi Railway. There is daily train operation between Kinshasa Central Station and Kasangulu Station. It is also located near the N1 (Kinshasa-Matadi Road) and good access to it. The function of the city could be considered with integration of the Study Area if necessary.

h) Agriculture Area

- Paddy Fields

Irrigation channels are observed in the marsh land of Limete Commune, Masina Commune and N'sele Commune along the Congo River. The Study Team has not been able to confirm the actual situation, but it is used for rice farming.

Rice farming is also observed along the banks of N'djili Commune and other small streams.

- Upland Field

  Dry field farming activities are observed especially in Kimpoko and Maluku Communes. Small upland fields in other areas are observed in the satellite images, but the current situation is not confirmed.

- Forest Industry

  Forests are used for the collection of firewood for sale.

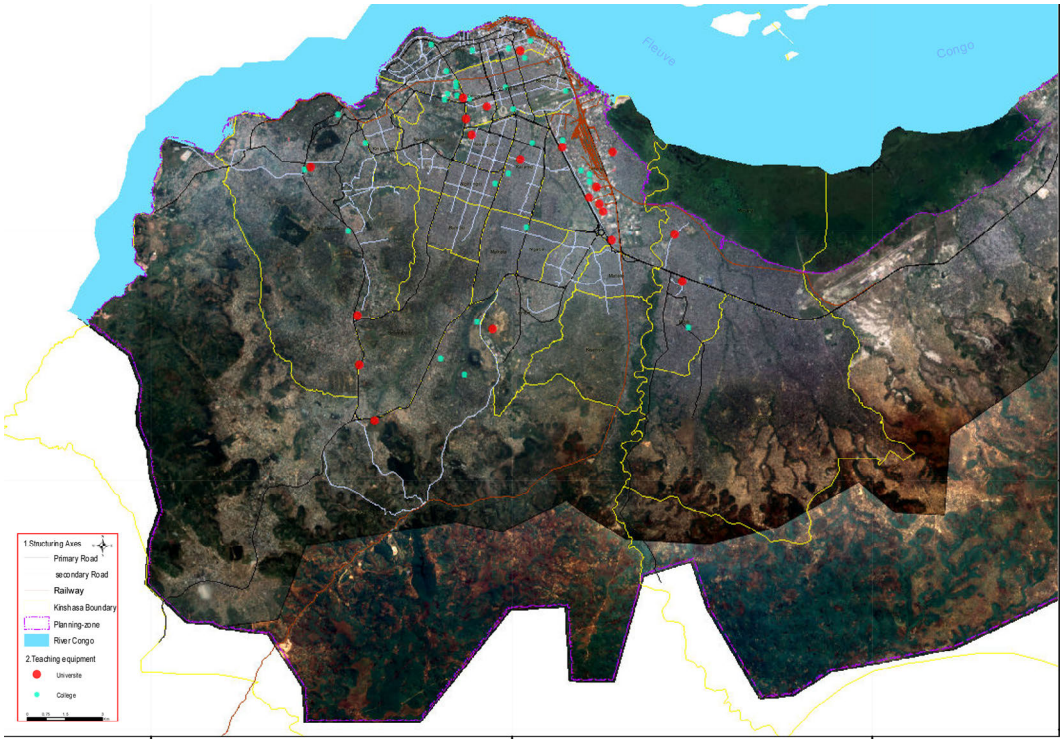
- Fishery

  Fishery activities are observed along the Congo River. Some fishermen dwell in marsh land along the river and islands of sandbars in the middle of the river. Maluku is one of landing port of fishing boats.

i) Other Land Use

- Educational facilities

  Kinshasa University is the largest higher education facility, which is located in Selembao Commune. Figure 3.3.2 shows the locations of higher educational facilities in the Study Area.



Source: The Study Team

Figure 3.3.2 Location of Higher Educational Facilities in the Study Area

- Military camp

  Military Camps are located in following communes. Housing developments have progressed in part of these camps. Deliberation of these changes and land availability need to be considered for future planning.

  - Bandalungwa Commune
  - Ngaliema Commune (2 camps)
  - N'sele Commune

3.3.2 Analysis of Recent Urbanisation

The analysis of current urbanisation trend (section 3.3.2) and land use changes (section 3.3.3) was intended to assure the population and employment estimated by the Study Team for the year 2017 from the INS statistical data which is only available up to 2015 at the most. In this section, the Study deals with the current land use of the Study Area and analyses its composition and structure.

(1) Data Sources Available for Land Use Analysis

For the analysis of the recent changes of urbanisation and land use of Kinshasa, the following sources are available.

- Satellite image of 2004 (offered by BEAU, part of the North West area of the Study Area)
- Satellite image of 2006/2007 (obtained by JICA in a former study, the image covers part of the Study Area between Mont-ngafula and N'sele, hereafter described "Image of 2006")
- Satellite image of 2014/2017 (obtained for this Study, the image covers part of the Study Area, hereafter described "Image of 2017")

The Study analyses the image of 2006 and the image of 2017 for identifying the land use changes.

(2) Typology of Urbanisation

The Study identifies areas and building sites which can be distinguished by comparison of the two different ages' images. The results of the comparison were classified into the following three categories of changes and recorded on a drawing of the Study Area.

a) Redevelopment (reconstruction of former buildings)

Changes of this typology correspond to those observed for a former buildings, former groups of buildings and a (group of) former housing site(s) in the already urbanized area. In these sites, reconstruction of buildings and urban redevelopment projects have been identified by the comparison of satellite images in 2006 and 2017.

For example, demolition of old flat houses and construction of new buildings with three to four stories and medium/high rise buildings with other functions (e.g. shopping mall, business offices) are the typical case of these changes.

b) Densification

Changes of this typology correspond to those observed for a progress of construction of buildings in sites which had been already cultivated and/or prepared as housing sites in the image of 2006. In these sites, densification of population with migrant people is supposed to be progressed.

c) Change of Land Use

Changes of this typology corresponds to changes observed as a transformation of land use from former agricultural fields, forest area and river banks into an urbanized (housing) area. It is supposed that these changes of landing and preparatory construction of housing sites have been executed in recent years. Housing construction and densification are expected to progress.

These areas exclude the sites where cultivation/landing/construction of housing sites and urbanisation have been executed simultaneously.

The Study classified changes of land use with housing construction as "Change of Land Use with Densification" separately.

d) Change of Land Use with Densification

In some urbanized areas, urbanisation, the construction of houses and settlement have progressed during the period from 2006 to 2017. The Study classified these areas as "Change of Land Use with Densification".

(3) Result of Analysis of Recent Urbanisation

Figure 3.3.3 shows land use changes in the Study Area between 2006 and 2017. In this section, the general trend of land use changes is described as follows.

- Redevelopment

  Redevelopment areas are observed mostly in the western part of the Study Area. Most of the redevelopment activities are small scale reconstruction, such as demolition of lower buildings and reconstruction of medium and/or high rise buildings.

  These changes are observed frequently along arterial roads and important roads in the communes. The redevelopments with improvement of roads are executed in some communes.

- Densification

  Migration and the densification had progressed in former peripheries of urbanised areas of 2006. These changes are observed in edge of the slope in the south, and in N'sele Commune, which was the eastern end of urbanisation in 2006.

  In the military camp near the centre of the urbanized area, the construction of small scale housing and barracks are observed to be constructed within these ten years.

- Change of Land Use

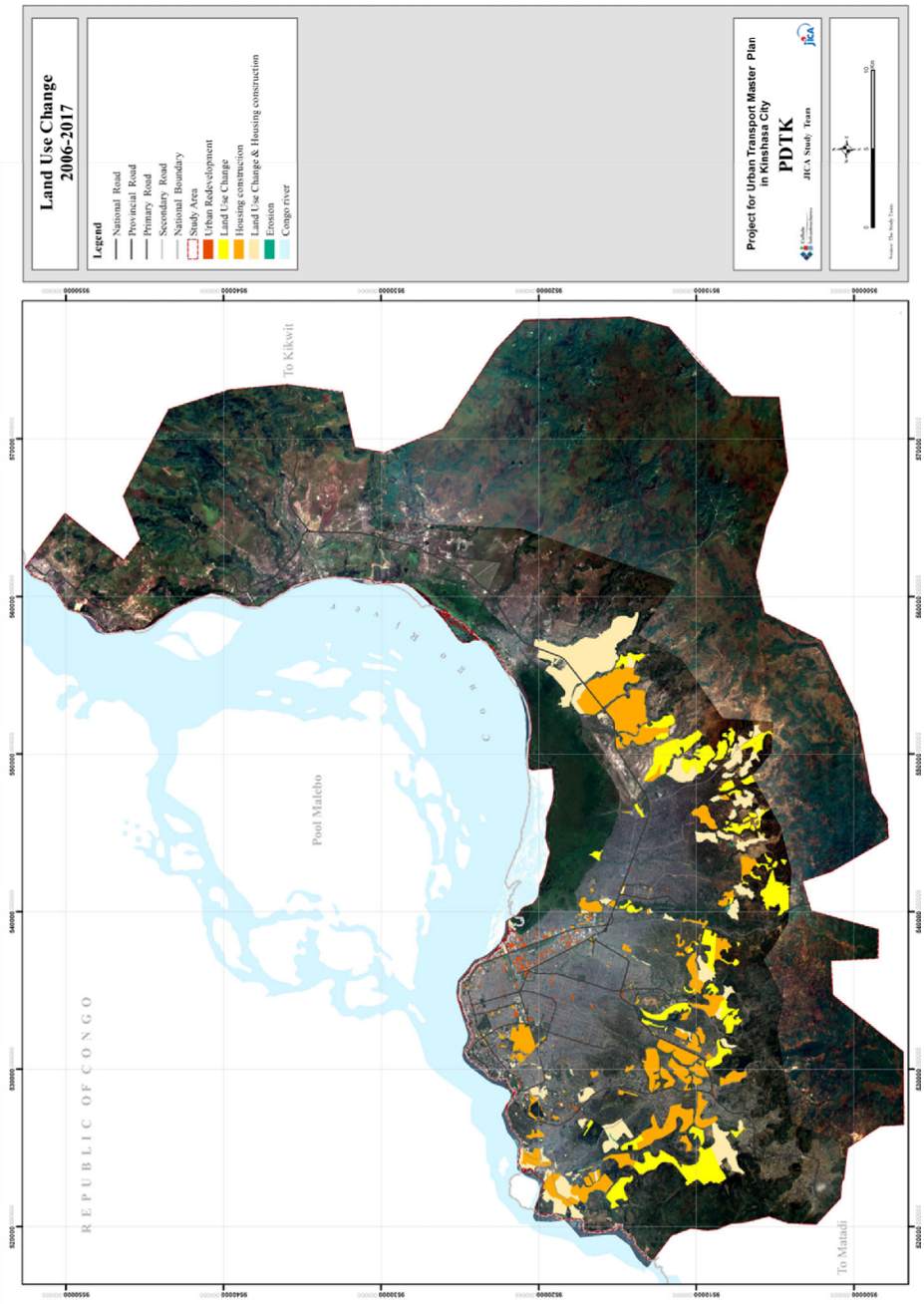
  The land use changes were observed in former agricultural fields and forest areas which neighbour the urbanized areas of 2006. These areas are watched in surrounding area of the former urbanized area in Mont-ngafula, Kinbansake and N'sele Communes.

  And progress of developments housing sites on the river bank and corresponding housing site development, such as of N'djili river, has also progressed.

- Change of Land Use with Housing Construction

  These urbanized areas are observed in adjacent areas of the areas, which had been developed in 2006. These areas are located along arterial roads and trunk roads, and have good access to the core area of each commune.

  In recent years, the development in the suburbs of Mont-ngafula, Kimbanseke, and N'sele has notable huge urbanized areas.



Source: The Study Team

Figure 3.3.3 Land Use Changes in Study Area between 2006 and 2017

3.3.3 Analysis of Land Use Changes by Commune

In this section, the Study describes notable changes of land use during 2006 to 2017. The following statement shows the general tendency of changes.

(1) Gombe Commune

- Reconstruction of lower buildings to middle/ high rise building.
- Land use change from residential housing into mixed building use with business and commercial functions.
- Change of agricultural space/open space to construction sites

(2) Limete Commune

- Reconstruction of buildings in industrial lots. It is supposed because of change of land owners and/or change of facilities.
- New constructions of industrial buildings as expansion of former facilities.
- Progress of construction of residential areas in the north east and north west of the commune

(3) Ngaliema Commune

- Progress of construction of housing and settlements in large scale zones of former public land.
- New developments in the former agricultural fields
- Reconstruction of the former lower buildings to middle-rise building with three to four stories as apartments or mixed use buildings.

(4) Kintambo Commune

- New developments with settlement in the former open spaces (supposed part of public land and river bank).
- Reconstruction of the former lower buildings in conversion to middle-rise building with three to four stories as apartments or mixed use buildings with commercial functions along trunk road in the commune and at major nodes.

(5) Barumbu Commune

- Reconstruction of former industrial lots, which have enough large space for group of housing and apartments into residential areas.
- Expansion and/or restructure of former industrial sites with construction of new buildings (e.g. factories).
- Demolishin former lower buildings into middle-rise building according to the progress of road improvement (ex. Kabinda Avenue, Kabambare Avenue). It is supposed to be related with the project with land acquisition.

(6) Kinshasa Commune

- Group of housing construction in the developed area.
- Reconstruction of buildings into middle-rise buildings along Huileries Avenue. It includes changes into large scale buildings with commercial functions (e.g. shopping centres, super markets).
- Demolishing former lower buildings into middle-rise building along Huileries Avenue and rue Mbomu. The latter is considered according to the progress of road improvement.

(7) Lingwala Commune

- Developments with changes of land use around the public facilities' area (surrounding area of stadium, Peoples' Palace, New National Museum).
- Change of land use and construction of residential zones.
- Reconstruction of buildings along major trunk roads (e.g. Pierre-Mulele Avenue, Huileries Avenue).

(8) Ngri-Ngri Commune

- Reconstruction of former lower buildings into middle-rise buildings with three to four stories.
- Construction of annex of educational facilities in order to expand the capacity.
- Reconstruction of buildings with spatial improvement of major trunk road (Assossa Avenue).

(9) Kasa-vubu Commune

- Small numbers of individual reconstruction of former lower buildings into middle-rise buildings with three to four stories.

(10) Kalamu Commune

- Reconstruction of former lower buildings into middle-rise buildings with three to four stories along major trunk road (e.g. Bongolo Avenue).
- Preparation and construction of housing sites in the former open space along water stream (it is considered spillway of the area).

(11) Lemba Commune

- Reconstruction of former buildings into new buildings in the foot of slope area of the commune (along bypass and around Rond Point Ngaba).
- Construction of housing site in former open spaces in the surroundings of the former housing site. Some of these areas are supposed to be in adequate geographical conditions.
- Construction of housing sites and urbanisation in the site along the water course on the east boundary of the commune.

(12) Matete Commune

- Quite few activities of reconstruction of former buildings.
- Development of large scale area with construction of urbanized sites in former agricultural areas in the bank of N'djili River.

(13) Bandalungwa Commune

- Progress of housing construction is observed in the military camp and surrounding development site. Especially, construction of barracks in the military camp is remarkable.
- Some reconstructions of former buildings are observed.
- Housing site development had been executed in the limited space along the river on the west border of the commune.

(14) N'djili Commune

- Part of the former open space (supposed to be a buffer green zone) along the N1 had been redeveloped and used for urban functions.
- Some large scale lots in the commune had been redeveloped with the construction of new buildings.
- Construction of new buildings in the public facility sites is observed. It is considered a sort of expansion of existing facilities.

(15) Ngaba Commune

- Quite few changes are observed in the commune.
- It is supposed to be because of too much dense situation of living environment and lack of capital for improvement and changes.

(16) Selembao Commune

- Construction of the housing and settlements had been progressed in the housings sites in the south of the commune. The area is located in the valley of watercourse. The surface of these housing sites leach about 1/3 – 1/2 of the whole area of the commune.

(17) Bumbu Commune

- Quite a few small reconstruction activities and construction are observed in the commune.
- It is supposed to be because of too much dense situation of living environment and lack of capital for improvement and changes.

(18) Makala Commune

- Quite a few small reconstruction activities and construction are observed in the commune.
- A Reconstruction activity in a large site in the northern part of the commune is supposed to

corresponding to expansion of capacity of public facility.

(19) Kisenso Commune

- Construction of housing and settlement had progressed in the developed areas of 2006. These areas are located in sloping areas and along the river.
- There remain quite few spaces, except some space in bank of N'djili River, to be developed in future.

(20) Masina Commune

- Development activities are observed in the former industrial facility near N'djili Airport.
- Development activities are observed in marsh areas north of the urbanized area. This urban expansion is the violation of the control of prohibition of development in the north of the railway track.

(21) Kimbanseke Commune

- The urbanised area had been expanded drastically in the southern area of the commune.
- Not only the progress of settlements into the developed lands, other development activities is observed in the areas where the accesses to other areas are difficult (e.g. the opposite side of river and valley from urbanised area).

(22) Mont-ngafula Commune

- The urbanised area had been expanded drastically along the northern boundary of the commune, which is adjacent area or urbanised area.
- Former urbanised areas of Mont-ngafula are located along N1 and bypass. But these urbanised areas had been expanded along other communal trunk roads and sprawling.

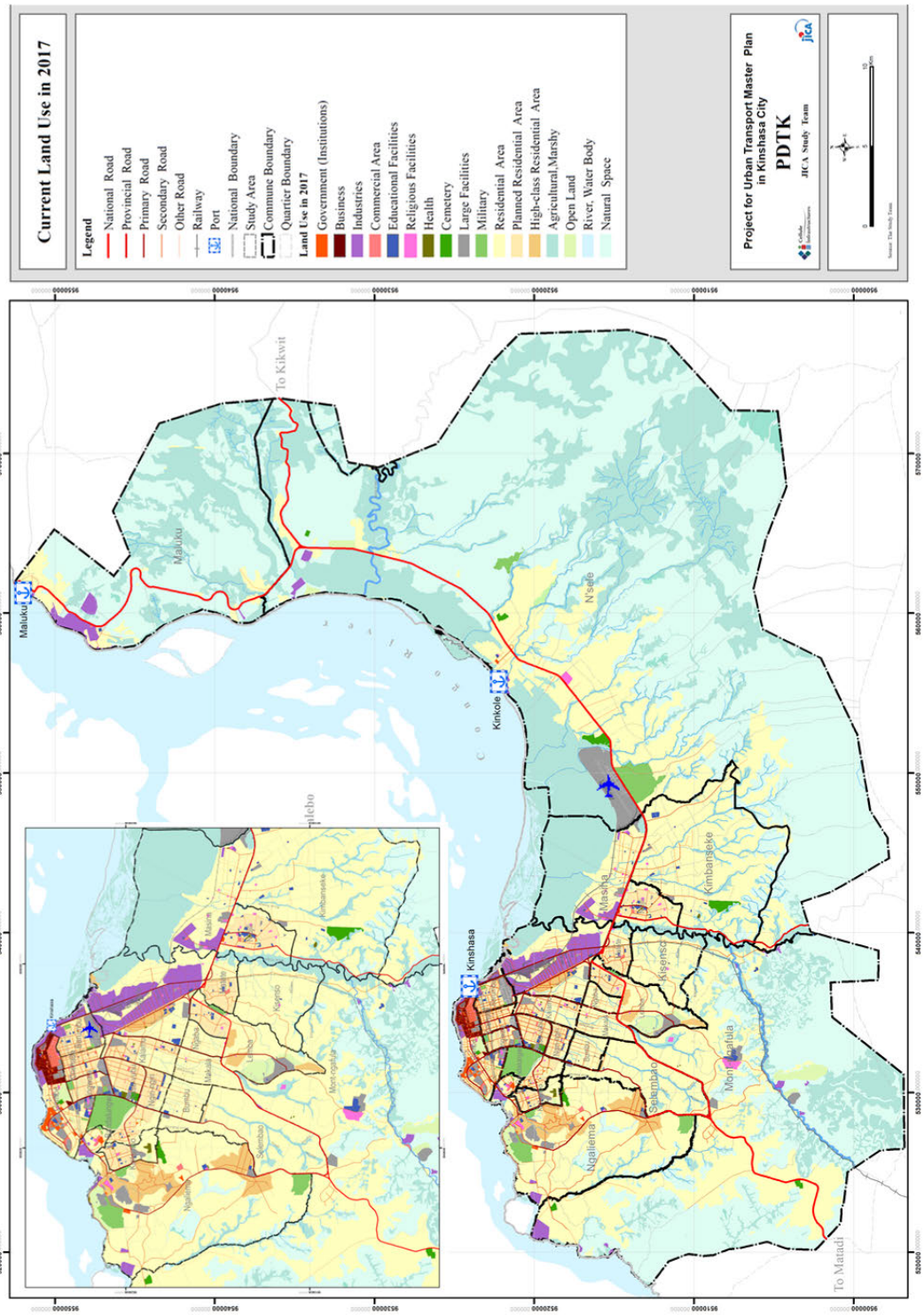
(23) N'sele Commune

- Huge areas along N1 had been developed in these ten years. These areas are used for small size housing.
- There exists neither major industry nor working places in this area, and most of these areas are used for housing with manual industry, small commercial shops and minute agriculture.

(24) Maluku Commune

The study couldn't find a referential image of 2006 for the Maluku Commune.

Commune names and locations are presented in Figure 3.3.4.



Source: The Study Team

Figure 3.3.4 Commune Names and Locations in the Study Area

3.4 Current Transport Systems and Issues

3.4.1 Road Network in Surrounding Study Area

(1) International Road Network

DRC is connected with such international road networks as the Trans-African Highway (TAH) which consists of nine main corridors with a total length 5,450 km; Sub-Sahara Africa Transport Policy Programme (SSATP) Transport Corridors, of which Matadi-Kinshasa-Bumba-Kisangani Corridor is corresponding with RN 1 in Kinshasa City; and the Southern African Development Community (SADC) Regional Corridors.

(2) Road Comparison in COMESA

According to the statistics published by The Common Market for Eastern and Southern Africa (COMESA):

Road Network Density (RND) of DRC in COMESA is just 0.07 km/sq. km for all roads and 0.00 km/sq. km for paved road.

A road length in COMESA is just 2.6 km/1,000 people.

Compared to the member countries of COMESA, DRC is relatively less developed in terms of unit density and length of the nationwide road network.

(3) Road Network and Classification in DRC

The total road network of the DRC is approximately 153,200km in length and comprised of the roads managed by the following authorities:

- Approximately 58,100km (38%) of national and provincial roads, supported by the Ministry of Infrastructure, Public Works and Reconstruction (MIPTR), under the management of the Road Agency (OR);
- Approximately 7,400km (5%) of urban roads under the management of the Office of Roads and Drainage (OVD);
- Approximately 87,700km (57%) of local roads or agricultural roads to be managed by the Ministry of Rural Development, under the management of the Directorate of Agricultural Roads (DVDA).

(4) OR Roads

The total length of roads managed by OR is 58,149km, which consists of 20,683 km of national and 37,466 km of provincial roads.

In 1990, the MIPWR has defined a practicability priority network of 30,788 km and which accounts for 53% of all the OR roads (58,100 km as shown in Figure 3.1.1) to fulfil the following main features:

- It focuses on the three main transport corridors; namely, West - Northeast, North - South and

West - Southeast; linking the provincial capitals and the main administrative centres;

- It accounts for more than 90% of road traffic;
- It joins the railway and river network;
- It serves all areas with high economic potential and population density;
- It includes the main routes of regional integration.

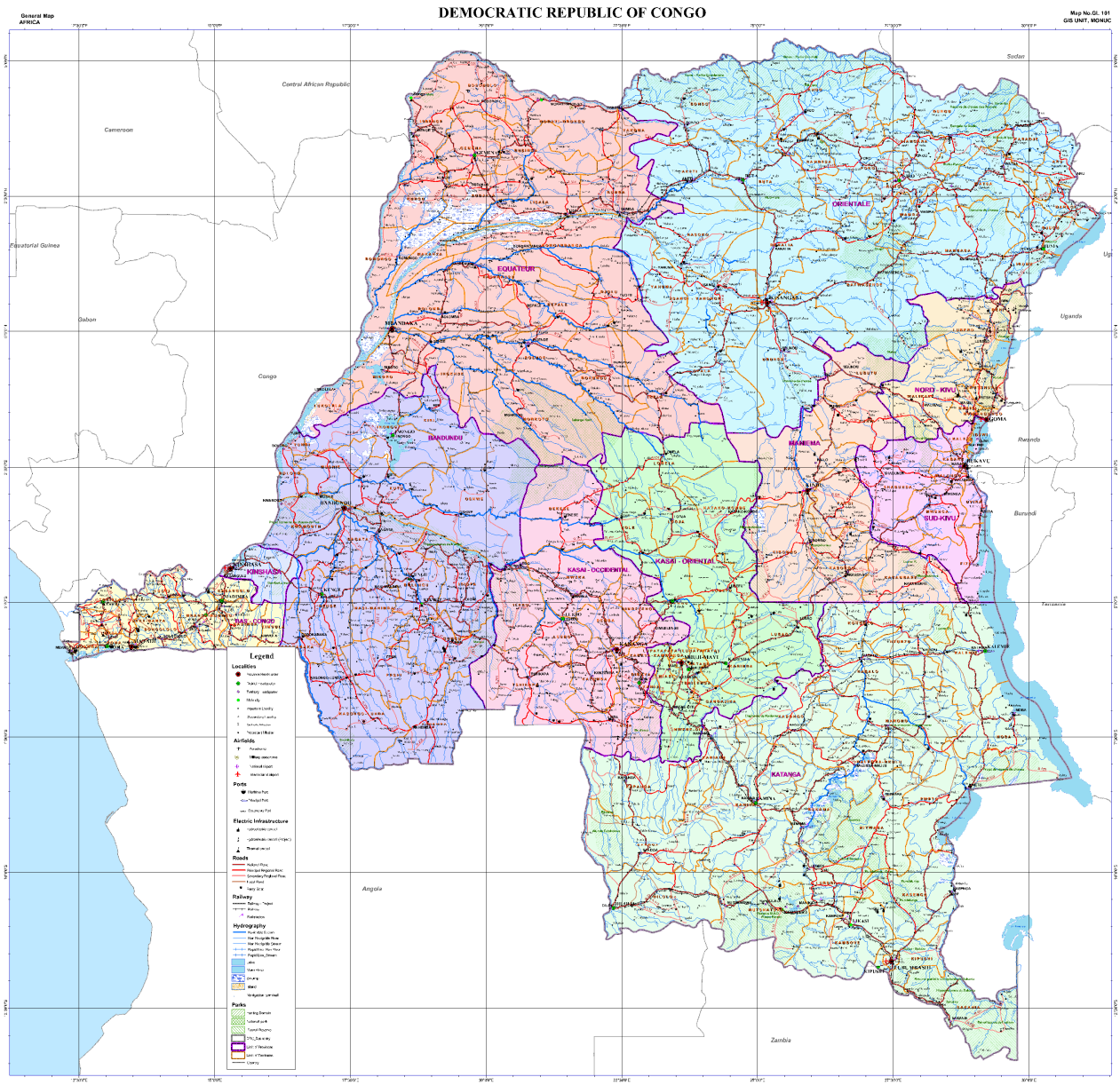
(5) OVD Roads

According to the "IDENTIFICATION AND CLASSIFICATION OF COATED ROADS IN KINSHASA, 1986", the network of roads under the management of the OVD are divided into four categories as shown in Table 3.4.1.

Table 3.4.1 Road Classification by OVD

Classifications	Definitions
Primary Road Network	− Great roads of penetration, clearing and bypass of the city centre, − Wide cross-sections of the city, − Roads in the centre of the village, especially around the market, in the shopping centre and in the administrative centre, − Main access roads to major administrative entities, − Various utility junctions.
Secondary Road Network	− "Major" roads giving access to the primary network or evacuating it to major administrative entities, − relief roads of the primary network, − Roads currently used by public transit vehicles, − Roads of public interest.
Tertiary Road Network	− Complementary roads of the mesh of the secondary network for a better service of the districts, − Secondary network relief routes, − Roads from the urban centre.
Local Road Network	− Rather, they are roads and lanes for access to houses, residential units and are not, in general, roads classified in the first three categories. − The local road network is of more interest to local residents. It is characterized by large pedestrian traffic, a light car park at night, the low traffic speed and the narrowness of the streets.

Note: excluding private roads. Source: Identification and Classification of Coated Roads in Kinshasa, 1986, OVD



Source: OR

Figure 3.4.1 National Road Network in DRC

3.4.2 Road Network in Kinshasa City

(1) Composition of Urban Roads

A total length of roads managed by OR and OVD in Kinshasa City is 3,621km, comprised of 251km of OR road network (7 %) and 3,370km of the OVD road network (93 %).

The road network of the OVD consists of 69.67km of Primary Road Network (2.1 %), which is more than 4-lane road, 337.56km of Secondary Road Network (10.0 %), 277.77km of Tertiary Road Network (8.2 %) and 2,685km of Local Road Network (79.7 %).

(2) General Conditions of the Road Network in Study Area

Existing road conditions in the Study Area are generally characterized by the areas as shown in Figure 3.4.2 through Figure 3.4.5 and explained as follows:

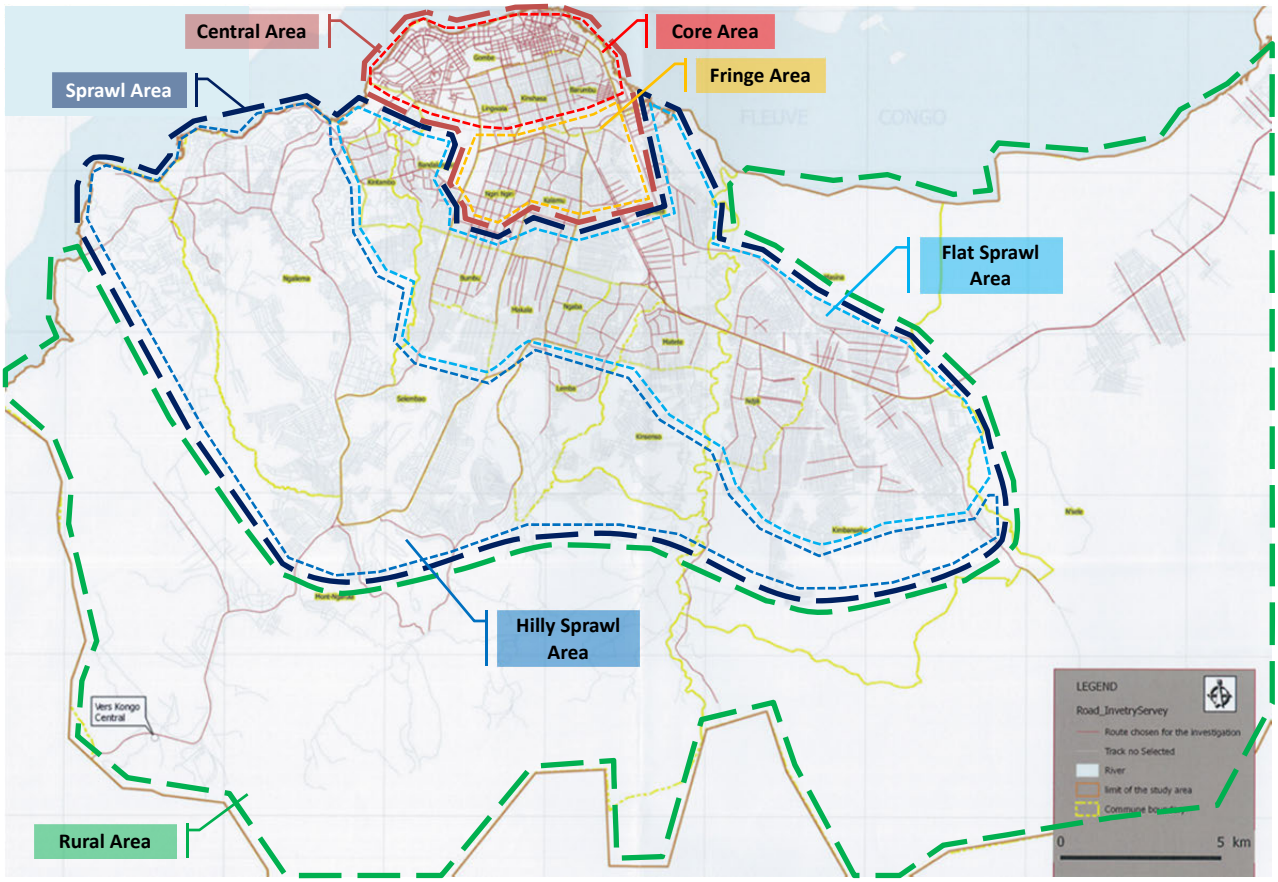
a) Central Area

As it was mentioned before, the road network in central Kinshasa City is rather dense and laid out on a grid in accordance with the Local Development Plan (PLA) in 1967. The road network, therefore, looks systematically well-developed and seems to have a road hierarchy. Also, this area is divided into two categories depending on the functions; namely, the one is the core area such as Gombe, Lingwala, Kinshasa and Barumbu Communes and the other is the fringe area such as the northern parts of Ngiri-ngiri and Kalamu Communes.

In the core area, road surface types are mainly paved and the surface conditions are rather better due to good road maintenance. The pipes of water supply buried under road pavement, however, are torn, water stains are on road surface and causes the destruction of roads in many places. On the other hand, the surface types in the fringe area are paved for main roads and unpaved for minor roads. The paved main roads, however, are deteriorated, with a lot of potholes and peeled surface due to insufficient road maintenance.

b) Sprawl Area

After independence from Belgium, the road network has been developed in disorder without any plan to accommodate the population growth. The area spreads to the peripheral of the central area excluding the north and the due east area due to the geographical constrain of the Congo River. Also, this area is divided into two categories depending on the terrain; namely, the one is the hilly sprawling area in the south of the central area such as Ngaliema, Selembao, Lemba and Kisenso Communes and the another is the flat one in the South and East of the central area such as Bumbu, Makala, Ngaba, Matete, N'djili and Kimbanseke.



Source: The Study Team

Figure 3.4.2 Existing Road Network by Areas within the Study Area

BLD. 30 JUIN in Core Area

GAMBELA in Fringe Area

TABU LEY in Core Area (Water Leak)

KATANGA in Fringe Area

Source: The Study Team

Figure 3.4.3 Photos in Central Area

At first glance, the road network in the flat area looks dense and is laid out in a grid. It is, however, a long and narrow grid. And, the road hierarchy seems to consist of two classes; namely, main and minor roads; also, the intervals of the main roads aren't arranged suitably. Especially, the main roads in the east-west axis are less, compared with the north-south axis. Moreover, the roads are cut off at many places by rivers and streams. On the other hand, the road network in the hilly area is developed depending on the topography and is disconnected by valleys and steep slopes. It looks that many small clusters made by minor roads hanging on to a main road which is limited and passes on the ridge of hills.

The surface types in the sprawl area are paved for the main roads and unpaved for minor roads, the same as those in the fringe area. The roads in the flat area, however, are often destroyed by rivers and streams or have huge holes in many places and it is difficult to pass through them, even in the dry season. On the other hand, the roads in the hilly area keep better than the flat ones. Several main routes, however, are deteriorated, such as the by-pass.

UNIVERSITE in Flat Sprawling Area

LIBERATION in Hilly Sprawling Area

ELENGESA in Flat Sprawling Area

BY-PASS in Hilly SprawlingArea

Source: The Study Team

Figure 3.4.4 Photos in Sprawl Area

c) Rural Area

This area is located at the far side of the sprawl area such as Mont-ngafula, N'sele and Maluku Communes. This area basically consists of a ribbon-developed area and small town area. The road network in this area, therefore, is undeveloped and coarse.

The surface types in the rural areas are paved for national roads and unpaved for other roads. The surface conditions for national roads are good to ordinary. On the other hand, the surface conditions for other roads are ordinary to bad.

Lumumba in Rural Area

RN43 in Rural Area (Maluku)

Source: The Study Team

Figure 3.4.5 Photos in Rural Areas

3.4.3 Issues on Road Development, Maintenance and Management and Drainage

(1) Issues on Road Development

Through the review of the current situation involved with the road development, the issues are summarized as follows:

- Poor Road Network
- Disrepair of the Existing Roads
- Budget Shortage and Low Capacity for Road Development

(2) Issues on Road Maintenance and Management

- Shortage of Construction Equipment for Road Maintenance
- Insufficient Budget for Road Maintenance

(3) Issues on Drainage and Discharge Capacity

- Insufficiency of Data to Adequately Assess the Capacity of the Actual Drainage System
- Insufficient Budget for Drainage System Maintenance

3.4.4 Issues on Traffic Safety, Control and Management

General issues in ensuring traffic safety, improving traffic control and management are identified and summarized as follows:

(1) Issues in Ensuring Traffic Safety

- Evidence based approach - identifying places with frequent traffic accidents and their causes
- Enhancing education regarding an awareness of traffic safety

- Inadequate traffic signals at locations with a high risk for traffic accidents
- Maintaining traffic discipline
- Improving non-motorized traffic facilities
- Road safety audit for existing and new roads

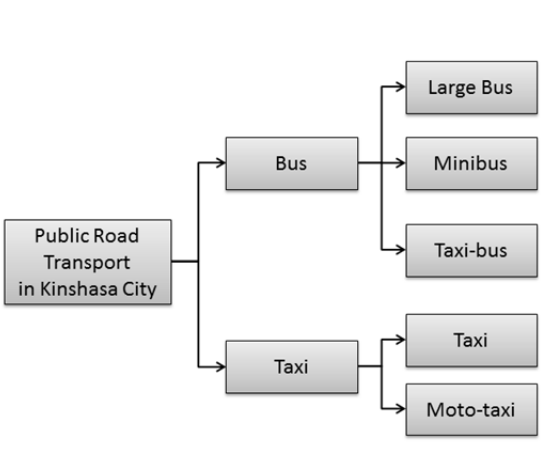
(2) Issues in Relieving Traffic Congestion

- Poor road conditions with irregular maintenance
- Road network with limited connections
- Lack of maintenance of traffic signals and inflexible signal phasing/cycle
- Lack of proper enforcement and traffic control
- Inadequate parking policy and management, including policy and management regarding stopping vehicles
- Lack of planning and coordination between land use and transportations

3.4.5 Public Road Transport

(1) Modes of Public Road Transport

The modes of public road transport can be categorized as large buses, minibuses, taxi-buses, taxis, and moto-taxis. Some of the large-sized buses and minibuses are operated by public enterprises, while most of the remaining services are owned or run private companies or individuals as shown in Figure 3.4.6.



Public Enterprise	Private Company /Individual
Transco New TransKin	-
New TransKin Transco	Esprit de Vie
-	HiAce Combi Esprit de Mort
-	Ketch
-	Wewa

Source: The Study Team

Figure 3.4.6 Outline of Public Road Transport in Kinshasa City

Buses can be classified into three types; large bus, minibus and taxi-bus. Large buses with 40 to 50 seats are mainly operated by TRANSCO, a public enterprise, while the minibuses with 29 seats are mainly operated by New TransKin, another public enterprise, and by individuals who operate private minibuses known as Esptit de Vie (Sprit of Life). On the other hand, taxi buses with about

fourteen seats known as Hiace, Combi and Esprit de Mort (Sprit of Death) are owned and operated mainly by individuals.

(2) Public Road Transport Organization

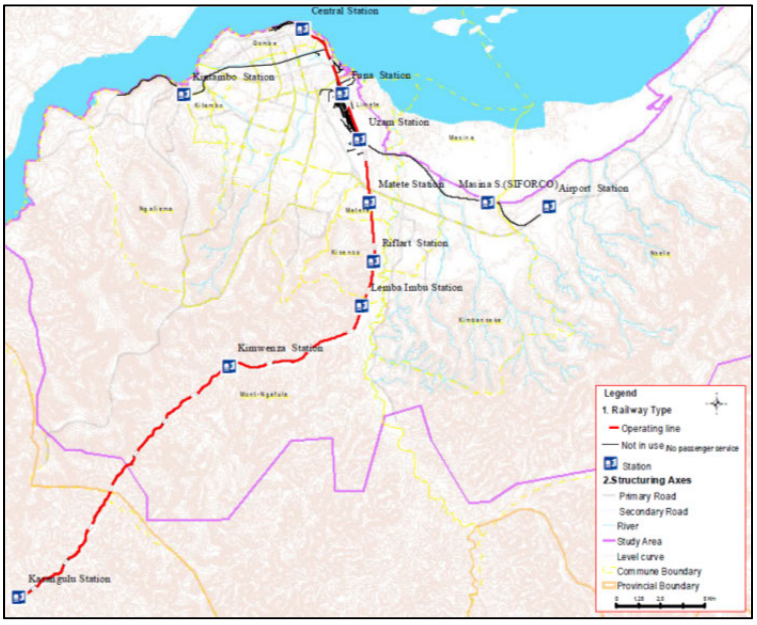
There are two public bus companies in Kinshasa City: Transco and New TransKin. APVCO is the association for owners of public buses purchased from the national Government. Similarly, ACCO and ANIPTMC are the association for professional drivers for private vehicles including the taxi and buses, and association for moto-taxies, respectively.

3.4.6 Railway

(1) Railway Operation and Network

The railway is currently operated by the SCTP (*Société Commerciale des Transports et des Ports* / Commercial Society of Transport and Ports) between Matadi and Kinshasa City and also operates an urban railway service from Kinshasa to Kasangulu.

The only urban railway line currently under operation is the line from Kinshasa Central Station toward Kasangulu, located around 45km from the Central Station, via Kimwenza, located around 23km from the Central Station, sharing the same track with the Matadi-Kinshasa railway while the railway lines to Kintambo and N'djili airport are not in operation in 2018. The line to N'djili Airport has stopped operation since 18th September, 2015 due to financial problems while the line to Kintambo terminated the train operation in 2007. The railway network around Kinshasa City is shown in Figure 3.4.7.



Source: The Study Team based on the interview survey with SCTP and GIS data from CI in 2016

Figure 3.4.7 Urban Railway Network in Urbanized Kinshasa City

(2) Train Operation and Transport Demand

Due to a limitation in the number of locomotives, the only operated trains for the urban area of Kinshasa City is I41 from Kasangulu to Kinshasa in the morning and I48 from Kinshasa to Kasangulu in the evening with one locomotive and eight passenger wagons. In 2018, trains are operated only during weekdays.

The daily average number of passengers for a weekday is approximately 1,600 as of 2017. In general, the number of passengers is holding a declining trend due mainly to the abandonment of railway lines to Kintambo and N'djili Airport. In addition, the number of passenger urban railway service to Kasangulu is also declining.

Transported cargo volume by the entire Railways Department is also in a declining trend since 2006. The transported cargo volume in 2016 was approximately 56,000 tonnes. Major imported items are general cargo, malt, flour and salt while major exported items are wood logs and wood products.

The current urban railway service with one round trip of operation per weekday is far away from the modern urban transport system of other metropolitan areas in the world. Problems are observed in almost all aspects such as train operation, passenger demand, finance, infrastructure and rolling stock and institutional aspects. In order to function as a part of an urban transport system, significant policy intervention is required.

3.4.7 Riverboats, Ports and Airports

(1) Maritime Ports

Although Kinshasa City does not face the ocean, a significant amount of goods are transported from three maritime ports at Matadi, Boma and Banana. Along with the rapid economic growth of the nation as well as the capital of Kinshasa City, the cargo handling volume of the three major maritime ports in tonnes show a significant increase over last fourteen years. The volume of 2015 exceeded 3 million tonnes per year which is around 2.5 times compared with 2002.

In addition to overall cargo handling volume in tonnes, container handling volume at Matadi Port is drastically increasing since 2006. The handling volume was doubled in a decade. It reached approximately 170,000 TEU (Twenty-foot Equivalent Unit) in 2016.

(2) Kinshasa Port and Fluvial Transport

Despite the rapid increase of cargo handling volume at three maritime ports, a declining trend is observed at Kinshasa Port since 2012, though it increased from 2006 to 2010. In terms of port operators, the share of private ports is significantly increasing. As of 2015, the share of private ports exceeded 90%.

The total container handling at Kinshasa Port including handling by vehicles, railways and fluvial transport was around 3,500 TEU in 2015. The total volume is around 3,000 to 4,000 TEU from 2009 to 2015 except for 2012. It is also noteworthy that container handling by river boat is significantly smaller than other modes of transport.

In addition to inland waterway transport in the DRC, international cargo is handled at Kinshasa

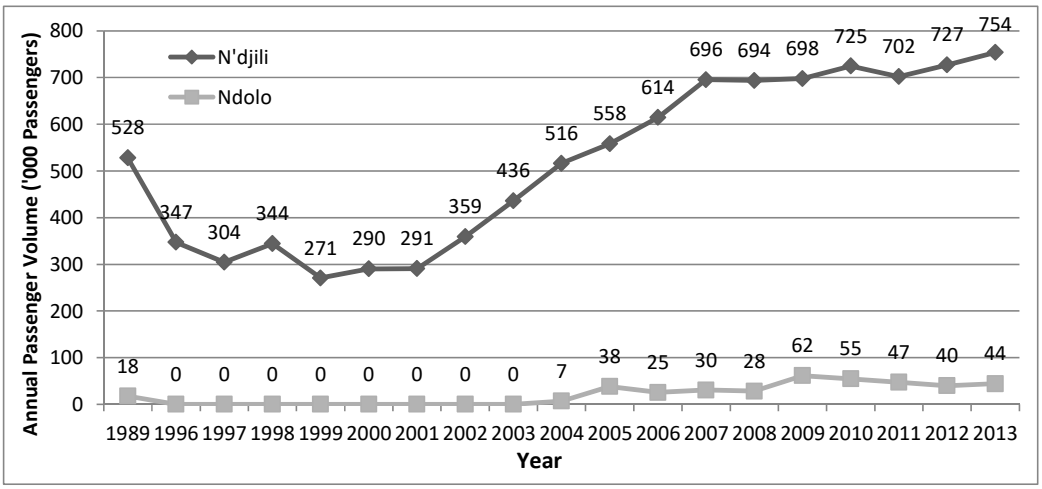
Port. According to CICOS (International Commission of the Congo-Oubangui-Sangha Basin, *Commission Internationale du Bassin Congo-Oubangui-Sangha*), the cargo handling volume of the Kinshasa-Brazzaville route was around 371,000 tonnes per year as of 2012. The passenger transport between Kinshasa City and Brazzaville is operated by two state companies on both banks. The departure and arrival of passengers at Kinshasa Port of the Kinshasa-Brazzaville route is operated by two state companies with over 810,000 passengers in 2012. In the Study Area, there are two major airports, N'djili International Airport and N'dolo Airport which is located in the city centre. The annual trend of aircraft movement, passenger and cargo demand of N'djili Airport are described in Section 3.4.3.

3.4.8 Air Transport

The aircraft movements of two major airports at N'djili and N'dolo located in the Study Area, in general in a declining trend as of 2013 despite a global trend of increasing aircraft movements due to low cost carriers. For further details, recent airport statistics are awaited. Comparing the two airports, the number of aircraft movements at N'dolo Airport is around 15% of that of N'djili.

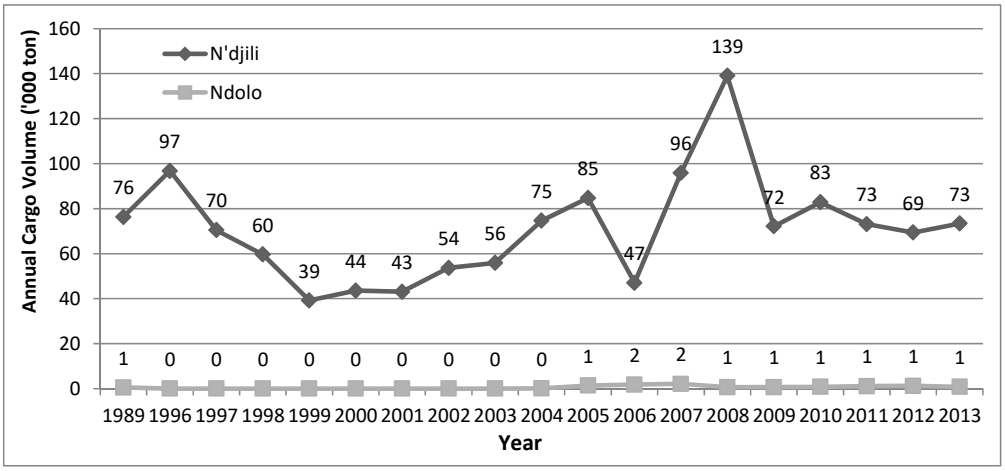
Apart from a slightly declining trend of aircraft movement, a significant increase of air passengers has been observed since 2001. Comparing N'djili and N'dolo Airports, the number of passengers of N'dolo Airport is almost 6% of N'djili Airport. This implies that the closure of N'dolo Airport for urban development, which is proposed in the SOSAK, might not give significant impact to N'djili Airport in terms of number of passengers.

Air cargo demand is, in general, also in an increasing trend except for fluctuation from 2006 to 2008. Together with passenger demand, further increase of cargo demand is also expected. The cargo handling volume of N'dolo Airport is much smaller than that of N'djili.



Source: "Service Statistique de la RVA" cited by "Annuaire statistique 2014 de la RDC", 2015

Figure 3.4.8 Annual Passenger Demand of Two Major Airports in Kinshasa City



Source: "Service Statistique de la RVA" cited by "Annuaire statistique 2014 de la RDC", 2015

Figure 3.4.9 Annual Cargo Volume of Two Major Airports in Kinshasa City

3.5 Prerequisites for Development Planning

3.5.1 Development Potentials and Constraints

Referring to the result of the analysis on recent development in Kinshasa, the following matters have conducted the orientation of urbanization and development in the Study Area.

(1) Distance from the Centre of Economy

Except for some trends to go out from the overcrowded communes in the centre of the city, much of the development has been implemented near the central area and the city has been grown as sprawling with development in periphery areas.

In the 1960s, the Master Plan of the city planned the concept of a sub centre in N'djili. At that moment, there was a development concept to construct secondary urban cores separated from the existing urban space and to avoid an overcrowded environment. But in fact, development in later years had included these sub centres, and a huge single core urban space has been generated.

Because of limited job place and opportunity, people tend to gather in the urbanized place and near the centre of the city (e.g. Gombe Commune and its surroundings) or the centre of the area. As a result, the following development will be implemented on the edge of the recent development area, and seldom constructed in isolation without a strong policy of development.

(2) Accessibility to arterial roads

The direction of development has strong relation with accessibility to the centre of the quarter, the centre of the commune, and the centre of the city. Thus, the new development areas are located along the regional arterial roads, such as N1 (Kikwit- Kinshasa -Matadi), and its branch roads into inner area of each of the communes.

In periphery areas of the urbanized area, a new urbanized area has been constructed along the minor local road and/or farm road. Considering the limited budget, it is quite difficult to expect progress and success of satellite type of new town development and remote area development, which need the package of infrastructure facilities.

(3) Large scale inclined land

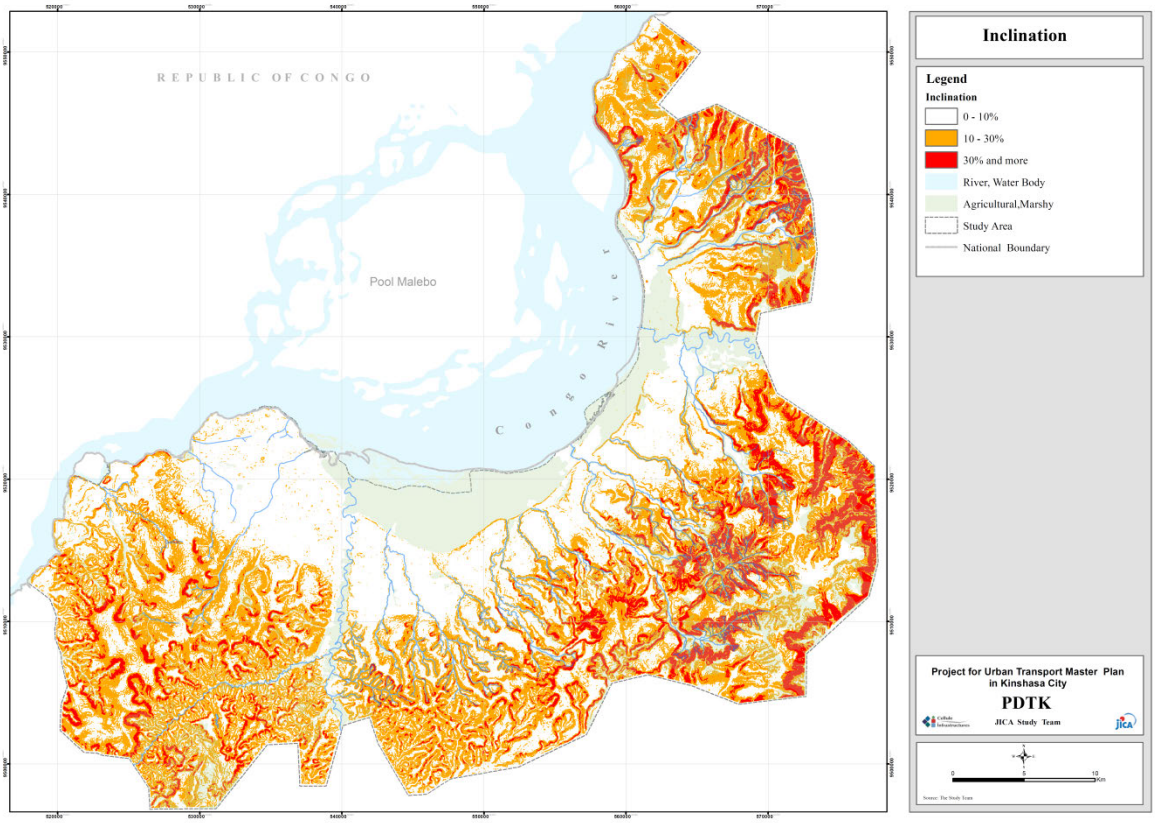
Especially in the case of the developments in periphery area, cultivation and urbanization has been executed in large scale slight inclined land. Some of them are former agricultural land, but others were forest land.

Even in communes near the centre of the city (e.g. Gombe), steep inclined lands had been developed later and in recent days. From this view, slight inclination is prior value in development in Kinshasa.

Figure 3.5.1 shows geographical situation of Kinshasa by sloping.

- No Colour: sloping less than 10%
- Yellow: sloping 10% to 30 %
- Red: sloping more than 30%

Considering recent development trend and existing urbanized spaces, the following urbanization will be executed in the slight inclined land between the Congo River and the steep slope areas in the south.



Source: The Study Team

Figure 3.5.1 Inclination of the Study Area

3.5.2 Legal Constraints on Development

(1) Urban Planning

For the planning of future development of the study area, it is necessary to grasp current status of the legal planning documents as introduced below.

a) Plans defined by the "Decree of the 20 June 1957 on Urban Planning"

The decree defines following 4 plans for development. The status of plans in Kinshasa and their legal relations with SOSAK should be clarified in the following study period.

1) General development plan and regulation (Plan général d'aménagement et des règles générales d'aménagement)

The descriptions are defined by the article 15 and 16 of the "Decree of the 20 June 1957 on Urban planning". These plan and regulations are approved by the National Congress and President.

2) Regional development plan (Plans régionaux d'aménagement)

The descriptions are defined by the article 13 and 14 of the "Decree of the 20 June 1957 on Urban Planning". Both general and regional development plans are approved by the Provincial assembly and Provincial Governor.

3) Local development plan (Plans d'aménagement locaux)

The plan is prepared by the district commissioner for cities under the provision of "Decree of the 20 June 1957 on Urban Planning". The plan is promulgated by Provincial Governor.

4) Development plan for particular area (Plans particuliers d'aménagement)

The plan is prepared for the particular area under the Decree of Provincial Governor for the district commissioner.

b) Other relating laws and regulations

In addition to the abovementioned development plans, following detailed descriptions should be confirmed for the further planning.

- Urban planning regulations

  Such as definition of urbanized area, general rules of land use for public or private use, main land use of the area

- Zoning regulations

  Residential area, Commercial/ Business area, Industrial area and Rural area are defined as major zone in the "Decree of the 20 June 1957 on Urban planning".

- Prevision of Natural Hazard area

  Defined in the article 4 and 5 of the "Decree of the 20 June 1957 on Urban planning".

- Reserved land for public interest

  Areas defined according to the development plan such as schools, health centre, green space, parks etc., defined in the article 55 of the Land law.

(2) Nature Conservation

As described in Section 3.1.4 "Flora, Fauna and Protected Area", there is no protected area for nature conservation in the Study Area. Also, there is no legal system to designate cultural and historical resources for protection in DRC.

3.5.3 Environmental Vulnerability

From field observations and discussions with the Stakeholders, the present environmental vulnerability of Kinshasa City that requires attention in future development scenarios can be summarized as shown in the following table.

Table 3.5.1 Environmental Vulnerability of Present Kinshasa City

	Aspects Related to Road and Transportation	Other Aspects
Environmental Pollution	• Most of the vehicles are reasonably well maintained but occasionally vehicles with black or white exhaust are observed. • Unpaved roads and ground surface are among the main causes of dust in the dry winter season. • Heavy road congestion at various places in the Target Area is contributing to air pollution.	• Burning of waste is common behaviour and causing air pollution. • Waste collection points on the roadside are sources of air and odour pollution. • Presently, public service of waste water collection and treatment is not available for most of the population. Great and urgent effort is necessary to accommodate further increase of population and industrial activities. • Daily life noises, such as amplified music, loud voices of bus conductors are the main source of noise pollution in most of the Study Area.
Natural Environment	• Many arterial and secondary roads have grown street trees that provide shade, mitigate dust pollution, and give town identity to local people. Public and private trees may be lost by new roads or urban development.	• Wetlands along the Congo River must not be urbanized for river bank protection as well as protection of the river ecosystem.
Socio-Economic Environment	• Many arterial and secondary roads are seriously under-maintained and remain in a condition where car access is difficult. General public living along such roads are forced to walk. • Large number of pedestrians are at high risk of traffic accidents because of insufficient provision of pavement, street lights and road crossing facilities. • Public transportation is well used but not well organized or disciplined. The general public is forced to pay higher fares on many occasions. • Heavy road congestions are observed at major cross sections, markets, potholes, and where the traffic volume surpasses the road capacity. Such congestion is the reason for many socio-economic deficiency, such as unpredictable public transportation, large number of commuters forced to walk, and loss of personal time and economic opportunities.	• Although the system of building permission exists, land use control does not exist in Kinshasa City. This situation is causing many vulnerabilities in the urban environment. • Houses are built to the edge of river and are very vulnerable to inundation. • Houses are built on steep slopes and are very vulnerable to erosion and slope failure. • Open spaces such as ROW of Road Lumumba are used for subsistence and commercial farming. Loss of such open spaces for urban development may affect many households and businesses. • Uncontrolled construction of residential structures is consuming farming area in peripheral Kinshasa City, which needs a good supply of fresh food materials • Wood and charcoal are used for cooking at most of the households. As the population increases, woodland shall be more vulnerable and scarce. • Rapid increase of population is causing insufficient supply of cemeteries. • Insufficient supply of waste and waste water management services is forcing a large number of the population to live in an unsanitary environment. • Open space in Kinshasa City consists of the green belts (including the Golf Club, Kokolo Camp and the Ndolo Airport), under-used road ROW and vacant plots. There is no provision of public parks where local children and residents can enjoy themselves outdoors safely.

Source: The Study Team

3.6 Scoping of SEA for Transport Master Plan

3.6.1 Screening

(1) Project components

The project components of the Study are summarised in Table 3.6.1.

Table 3.6.1 Project Components of the Study

Phase	Target Area	Project components	Phase and Output of the Study
Master Plan Phase	Kinshasa City (SOSAK planning area)	Development Scenarios toward 2040	a. Land use plan b. Economic development projection c. Population projection
		Urban Transport Plan Target existing road for inventory survey: Length (to be confirmed) List of Target existing Road: To be obtained List of newly proposed road: To be obtained	d. Public Transport Plan e. Road Development Plan f. Traffic Management Planning
		Project Implementation Plan	g. Identification of Projects h. Implementation Structures
		Preliminary Study on Priority Projects	i. Selection of Priority Projects j. Preliminary Feasibility Study k. IEE

Source: The Study Team

(2) Laws of DRC

According to the Decree No. 14/19 of August 2014, Article 4, the strategic environmental assessment covers the sectors of activity related to infrastructure, urban planning and transport. Therefore, the Study is required to submit the SEA report and go through the review process.

With the discussions between ACE and the Team in April and July 2017, the following adjustment to the process described in the Law were approved and agreed:

- Since the Study is in the policy making phase, the target of opinion inquiry described in the Title V of the Law shall be the key persons who are in the positions of decision making, including the members of JCC and TWG, and shall not include the Commune Chiefs or general public.
- Information to be used in the policy making phase shall be collected by literature and interviews with key people. Therefore, the Team is waived hiring the national consultant described in Article 10 during the SEA study. The Team shall hire a national consultant in the next Initial Environmental Evaluation phase for the selected Priority Projects because field surveys are necessary to collect detailed local information from the target project sites.
- The SEA report shall be reviewed by the Environmental Audit described in Title IV of the Law.

(3) JICA Guideline

According to "JICA Guidelines for Environmental and Social Considerations 2010", this Study falls in Category B that is required to conduct SEA in Master Plan Phase (Table 3.6.2). [5]

Table 3.6.2 Categorization Criteria of JICA Guideline

Category	Categorization Criteria
Category B	The project may have adverse impacts on the environment or society, but these impacts are less significant than those of Category A projects. These impacts are site-specific; few, if any, of them are irreversible; in most cases, they can be mitigated more readily than Category A projects. Responsibilities of the project proponents include the planning and monitoring of necessary Environmental and Social Consideration (ESC) activities. ESC procedures such as Strategic Environmental Assessment for Master Plan project and stakeholder participation may be required, depending on the scale and nature of the adverse impacts.

Source: JICA Guideline 2010

3.6.2 Scoping

(1) Policies, Regulations and Institutional Work Related to Environment and Development of Kinshasa City

Policies, regulations and institutional work related to the environment and development of Kinshasa City are explained in Section 7.3.

(2) Stakeholders Related to the Study

Stakeholders related to the Study are involved in the planning process since its start. Those stakeholders are organized in the Joint Coordination Committee and the Technical Working Group. Institutions attending such organizations are listed in the following table.

(3) General Conditions of the Target Area

General condition of the Target Area is explained in Section 3.1 through 3.3.

(4) Scoping: Potential Impacts Expected by the Implementation of the Study

Although the contents of the output, such as land use plan, are under study as of July 2017, it is possible to identify environmental and social items potentially affected, either positively or negatively, when the plan is implemented, from the Project Components listed in Table 3.6.1 and the general condition of the Target Area explained in Section 3.1 through 3.3. Such potential impacts expected by the implementation of the Master Plan are listed in Table 3.6.4.

[5] The GAP analysis between the EIA/IEE framework of DRC and the JICA Guidelines is included in Volume 2 and Volume 3 of this Report.

Table 3.6.3 Main Stakeholders of the Study

	Joint Coordination Committee	Technical Working Group (TWG)
Functions	• To approve work plans, review overall progress • To conduct monitoring and evaluation of the Study • To coordinate among the relevant organisations • To exchange opinions on major issues arising during implementation of the Study	• To work with the JICA mission on a daily basis and facilitate necessary arrangements for smooth implementation of the Study • To examine and analyse the technical aspects of the Reports • To coordinate and harmonise the stakeholders of the Study and ensure involvement of the concerned authorities • To prepare materials (reports/presentations) for JCC • To correspond to the requests/inquiries made by JCC on technical matters.
Members	Chair (Project Director): *Coordonnateur de la Cellule Infrastructures, Ministère des Infrastructures et Travaux Publics* <u>Members</u> *1) Conseiller Principal Infrastructures de la Présidence* *2) Conseiller Principal au Collège chargé des Infrastructures de la Primature* *3) Conseiller Planification, MITP* *4) One representative of Ministère Provincial du Plan, Budget, Travaux Publics et Infrastructures* *5) One representative of Ministère Provincial des Transports, Sports, Jeunesse et Loisirs* *6) One representative of Bureau d'Etudes d'Aménagement et d'Urbanisme* *7) One representative of Office des Voiries et Drainage* *8) One representative of Commission Nationale de Prévention Routière* *9) One representative of Groupe d'Etudes des Transports* *10) One representative of Office des Routes* *11) One representative of Société Commerciale des Transports et des Ports* *Ministère des Infrastructures et Travaux Publics* may select necessary representatives of relevant ministries and organisations other than indicated above.	Project *Manager: Le Chef de section voiries de la Cellule Infrastructures, Ministère des Infrastructures et Travaux Publics* <u>Members of the Democratic Republic of the Congo</u> <u>One expert from the below agencies</u> *1) Ministère des Infrastructures et Travaux Publics* *2) Ministère Provincial du Plan, Budget, Travaux Publics et Infrastructures* *3) Ministère Provincial des Transports, Sports, Jeunesse et Loisirs* *4) Cellule Infrastructures* *5) Bureau d'Etudes d'Aménagement et d'Urbanisme* *6) Office des Voiries et Drainage* *7) Commission Nationale de Prévention Routière* *8) Groupe d'Etudes des Transports* *9) Office des Routes* *10) Société Commerciale des Transports et des Ports* *11) Agence Congolaise de l'Environnement* *Ministère des Infrastructures et Travaux Publics* may select necessary expert(s) of relevant ministries and organisations other than indicated above.

Source: The Study Team

Table 3.6.4 Scoping: Potential Impacts Expected by the Implementation of the Study

Project components	Phase and Output of the Study	Environmental and social items potentially affected (positive / negative) when the plan is implemented		
		Pollution control	**Natural environment**	**Socio-economic environment**
Development Scenarios toward 2040	a. Land use plan b. Economic development projection c. Population projection	1. Areas affected by vehicle - oriented air pollution shall be expanded. 2. Distribution of point sources of domestic and industrial waste water shall be expanded and the total volume shall increase. 3. Waste generation area shall be expanded and the total waste volume shall increase.	4. Loss / protection of natural vegetation, farming land and urban green belt can be predicted. 5. Areas susceptible to inundation and flood damage can be predicted. 6. Future erosion potential may be predicted through land use plan/ development scenarios on slopes.	7. Future locations of housing and agriculture, and necessity of land use control shall be suggested. 8. Existing and future target area of public services and utility services can be recognized.
Urban Transport Plan	d. Public Transport Plan e. Road Development Plan f. Traffic Management Planning	9. Increased traffic speed and improvement of public transportation service shall reduce the emission of vehicle exhaust.		10. By implementing the Urban Transport Plan and Public Transport Plan,the general public shall enjoy better access of /to their work places, markets, schools, hospitals, etc.. 11. By implementing the Urban Transport Plan, the road and traffic safety shall improve and the number of traffic accidents per unit population shall decrease. 12. By implementing the Public Transport Plan, the consumption of transportation fuel per person shall be suppressed, as well as the emission of greenhouse gas in the Transport Sector. 13. The Road plan may suggest future, long-term relocation of businesses and residents on the road ROW. 14. By implementing the Road Plan, businesses shall enjoy better access to providers and consumers. 15. Road Plan (expansion) may suggest future loss of existing street trees. 16. By implementing the Road Plan, the network of all-season road shall expand and be improved. 17. When planned with insufficient work design, construction works on existing roads may cause road closures or serious traffic jams. 18. By re-designing the road space around the

Project components	Phase and Output of the Study	Environmental and social items potentially affected (positive / negative) when the plan is implemented		
		Pollution control	**Natural environment**	**Socio-economic environment**
				markets, congestion in front of the markets shall be reduced. 19. By the construction works for re-designing the road space around the markets, there will be businesses susceptible to temporal or permanent relocation. 20. By the construction of new arterial roads, the existing community may be physically split. 21. Construction of new roads or expansion of existing roads, may affect cultural and historical resources on or near the ROW may be temporally or permanently.
Project Implementation Plan	g. Identification of Projects h. Implementation Structures			22. Implementation plan may clarify decision making procedures in implementation of the Master Plan, including public involvement and grievance redress mechanism.
Preliminary Study on Priority Projects	i. Selection of Priority Projects	9. Increased traffic speed and improvement of public transportation service shall reduce the emission of vehicle exhaust.		23. The selected Priority Projects may require the relocation of businesses and residents on the ROW in the relatively near future. 24. If poorly planned, the construction works of selected Priority Projects may cause severe traffic jams or temporary road closure. 25. Selected Priority Projects may require the felling of existing street trees.
	j. Preliminary Feasibility Study k. IEE	IEE level study shall include field survey of; potential business and resident relocations, loss of open space or green areas, felling of street trees, and negative impacts on locally important places and facilities for Design Phase; and existing air and noise pollution, avoidance measures of road closure and traffic jams for the Construction Phase.		

Source: The Study Team

3.6.3 Strategy for Evaluation of Master Plan

(1) Environmental and Social Items to be Studied

Table 3.6.5 lists 31 environmental and social items listed in JICA Guideline evaluation format. Potential impacts expected by the implementation of the Study are placed in the relevant lines. As a result, out of 31 items, twelve items are omitted and nineteen items are selected to be studied further in the SEA.

Table 3.6.5 JICA Guideline Evaluation Format and Items Selected in the Scoping

	No.	Environmental Items	Environmental and social items potentially affected (positive / negative) when the plan is implemented
Pollution	1	Air quality	1. Areas affected by vehicle - oriented air pollution shall be expanded. 9. Increased traffic speed and improvement of public transportation service shall reduce emission of vehicle exhaust.
	2	Water quality	2. Distribution of point sources of domestic and industrial waste water shall be expanded and the total volume shall increase.
	3	Noise and vibration	Omitted because no significant impacts are expected in Table 3.6.4.
	4	Waste	3. Waste generation area shall be expanded and the total waste volume shall increase.
	5	Soil contamination	Omitted because no significant impacts are expected in Table 3.6.4.
	6	Ground subsidence	Omitted because no significant impacts are expected in Table 3.6.4.
	7	Offensive odour	Omitted because no significant impacts are expected in Table 3.6.4.
	8	Bottom sediment contamination	Omitted because no significant impacts are expected in Table 3.6.4.
Natural envi.	9	Protected areas	Omitted because no significant impacts are expected in Table 3.6.4.
	10	Ecosystem	4. Loss/protection of natural vegetation, farming land and urban green belt can be predicted.
	11	Water regime, flood, inundation	5. Areas susceptible to inundation and flood damage can be predicted.
	12	Geology	6. Future erosion potential may be predicted through land use plan/development scenarios on slopes.
Social and economic envi.	13	Involuntary Resettlement and/or Loss of Properties	13. The Road plan may suggest future, long- term relocation of businesses and residents on road ROW. 23. The selected Priority Projects may require the relocation of businesses and residents on ROW in the relatively near future.
	14	Poor	10. By implementing the Urban Transport Plan and Public Transport Plan, the general public shall enjoy better access of to their work places, markets, schools, hospitals, etc..
	15	Indigenous or minority groups	Omitted because no significant impacts are expected in Table 3.6.4.
	16	Local economy such as employment and livelihood	10. By implementing the Urban Transport Plan and Public Transport Plan, the general public shall enjoy better access of to their work places, markets, schools, hospitals, etc.. 14. By implementing the Road Plan, businesses shall enjoy better access to providers and consumers.
	17	Land use, Local resource use, Communal/Common resource use rights	7. Future locations of housing and agriculture, and necessity of land use control shall be suggested.
	18	Water rights/water use	Omitted because no significant impacts are expected in Table 3.6.4.
	19	Traffic/public facilities, infrastructures, social services	8. Existing and future target areas of public services and utility services can be recognized. 16. By implementing the Road Plan, the network of an all-season road shall expand and be improved. 17. When planned with insufficient work design, construction works on existing roads may cause road closures or serious traffic jams. 18. By re-designing the road space around the markets, congestion in front of the markets shall be reduced. 19. By the construction works for re-designing the road space around the markets, there will be businesses susceptible to temporal or permanent relocation. 24. If poorly planned, the construction works of selected Priority Projects

	No.	Environmental Items	Environmental and social items potentially affected (positive / negative) when the plan is implemented
			may cause severe traffic jams or temporary road closure.
	20	Social institutions such as social infrastructure and local decision - making institutions	22. Implementation plan may clarify decision making procedures in implementation of the Master Plan, including public involvement and grievance redress mechanism.
	21	Uneven distribution of benefits and damages	Omitted because no significant impacts are expected in Table 3.6.4.
	22	Local conflict of interests	Omitted because no significant impacts are expected in Table 3.6.4.
	23	Physical splits of communities	20. By the construction of new arterial roads, existing communities may be physically split.
	24	Historical and cultural resources	21. Construction of new roads or expansion of existing roads, may affect cultural and historical resources on or near ROW may be temporally or permanently.
	25	Landscape	15. Road plan (expansion) may suggest future loss of existing street trees. 25. Selected Priority Projects may require felling of existing street trees.
	26	Gender	10. By implementing the Urban Transport Plan and Public Transport Plan, the general public shall enjoy better access of to their work places, markets, schools, hospitals, etc..
	27	Children's rights	Omitted because no significant impacts are expected in Table 3.6.4.
	28	Sanitation, Public Health Condition, Infectious diseases such as HIV/AIDS	2. Distribution of point sources of domestic and industrial waste water shall be expanded and the total volume shall increase. 3. Waste generation area shall be expanded and the total waste volume shall increase. 5. Areas susceptible to inundation and flood damage can be predicted. 8. Existing and future target areas of public services and utility services can be recognized.
	29	Industrial safety and health, working environment	Omitted because no significant impacts are expected in Table 3.6.4.
	30	Accidents, crime	11. By implementing the Urban Transport Plan, the road and traffic safety shall improve and the number of traffic accidents per unit population shall decrease.
	31	Climate change, transboundary impacts	12. By implementing the Public Transport Plan, the consumption of transportation fuel per person shall be suppressed, as well as the emission of greenhouse gas in the Transport Sector.

Source: The Study Team

(2) Selection of Indicators for Future Projection and Evaluation

Indicators proposed in the United Nations Sustainable Development Goals (SDG Targets 3.6, 9.1, 11.2.1, 13.1.1) are selected or modified as the indicators for evaluation where appropriate.

Indices proposed are shown in Table 3.6.6. Throughout the following survey, data availability was confirmed. Some indices may be dropped because of the lack of data.

Indices are selected to show the difference between the alternative development scenarios. When it was found that the impact cannot be measured quantitatively, or the alternatives do not make significant differences, the indices may not be used for evaluation, but are used to identify future goals and desirable environmental and social conditions for the particular item.

Indices for selection of Priority Project and for use in IEE phase of the Priority Project are formulated based on the indices listed in Table 3.6.6.

Table 3.6.6 Indices for Master Plan Evaluation

No.	Items	Environmental and social items potentially affected (positive / negative) when the plan is implemented	Proposed indices for Master Plan evaluation
1	Air quality	1. Areas affected by vehicle - oriented air pollution shall be expanded. 9. Increased traffic speed and improvement of public transportation service shall reduce emission of vehicle exhaust.	a. Gasoline consumption volume b. Vehicle-Kilometer index c. Qualitative evaluation of increase or decrease of pollutants from vehicular emissions d. PM10 emission volume from vehicles e. Gasoline consumption volume
31	Climate change, transboundary impacts	12. By implementing the Public Transport Plan, the consumption of transportation fuel per person shall be suppressed, as well as the emission of greenhouse gas in the Transport Sector.	
2	Water quality	2. Distribution of point sources of domestic and industrial waste water shall be expanded and the total volume shall increase.	f. Number of patients who suffers from diseases caused by unsanitary water (diarrhoea and parasites) and mosquito
28	Sanitation, Public Health Condition, Infectious diseases such as HIV/AIDS	2. Distribution of point sources of domestic and industrial waste water shall be expanded and the total volume shall increase. 3. Waste generation area shall be expanded and the total waste volume shall increase. 5. Areas susceptible to inundation and flood damage can be predicted. 8. Existing and future target areas of public services and utility services can be recognized.	
4	Waste	3. Waste generation area shall be expanded and the total waste volume shall increase.	g. Number of waste collection stations per unit population, h. Population per one waste collection station
10	Ecosystem	4. Loss / protection of natural vegetation, farming land and urban green belt can be predicted.	i. Types of open spaces and changes in the area
17	Land use, Local resource use, Communal/ Common resource use rights	7. Future locations of housing and agriculture, and necessity of land use control shall be suggested.	
11	Water regime, flood, inundation	5. Areas susceptible to inundation and flood damage can be predicted.	j. Number of population affected by natural disaster (per 100,000 people)
12	Geology	6. Future erosion potential may be predicted through land use plan/ development scenarios on slopes.	k. Ratio of developed land area out of total land area with high erosion potential
13	Involuntary Resettlement and/or Loss of Properties	13. The Road plan may suggest future, long- term relocation of businesses and residents on road ROW. 23. The selected Priority Projects may require relocation of businesses and residents on ROW in the relatively near future.	l. Expected number of structures for potential relocation

No.	Items	Environmental and social items potentially affected (positive / negative) when the plan is implemented	Proposed indices for Master Plan evaluation
14	Poor	10. By implementing the Urban Transport Plan and Public Transport Plan, general public shall enjoy better access of / to their work places, markets, schools, hospitals, etc..	m. Ratio of population who live within 500 m (or 2 km) from all-season road against the whole population. n. Ratio of population who live within 500 m (or 2 km) from the stations of mass transit system. o. Average commuting distance to the nearest centre of employment p. Average commuting time q. Vehicle-hour indicator shall be shorter and loss of hours can be used for productive purpose
16	Local economy such as employment and livelihood	10. By implementing the Urban Transport Plan and Public Transport Plan, general public shall enjoy better access of to their work places, markets, schools, hospitals, etc.. 14. By implementing the Road Plan, businesses shall enjoy better access to providers and consumers.	
19	Traffic/public facilities, infrastructures, social services	8. Existing and future target areas of public services and utility services can be recognized. 16. By implementing the Road plan, the network of all-season roads shall expand and be improved. 17. When planned with insufficient work design, construction work on existing road may cause road closure or serious traffic jams. 18. By re-designing the road space around the markets, congestion in front of the markets shall be reduced. 19. By the construction works for re-designing the road space around the markets, there will be businesses susceptible to temporary or permanent relocation. 24. If poorly planned, the construction work of selected Priority Projects may cause severe traffic jams or temporary road closure.	
26	Gender	10. By implementing the Urban Transport Plan and Public Transport Plan, the general public shall enjoy better access of/to their work places, markets, schools, hospitals, etc..	
20	Social institutions such as social infrastructure and local decision - making institutions	22. Implementation plan may clarify decision making procedures in implementation of the Master Plan, including public involvement and grievance redress mechanism.	r. Existence of public involvement and grievance redress mechanism in the implementation process of the Study, or its proposal
23	Physical splits of communities	20. By construction of new arterial road, existing communities may be physically split.	s. Number of communities (and total population) that are split by newly proposed road
24	Historical and cultural resources	21. Construction of new road or expansion of existing road, may affect cultural and historical resources on or near ROW may be temporally or permanently.	t. Number of cultural and historical resources that locates close to target roads
25	Landscape	15. Road plan (expansion) may suggest future loss of existing street trees. 25. Selected Priority Projects may require the felling of existing street trees.	u. Ratio of the length of target road with street trees against the total length of road with street trees
30	Accidents, crime	11. By implementing the Urban Transport Plan, the road and traffic safety shall improve and the number of traffic accidents per unit population shall decrease.	v. Number of death and injury per population of 100,000 caused by traffic accidents

Source: The Study Team

(3) Method of Future Project

Future projection of the indices for each Development Scenarios uses one or more method described below:

5) Projection of indicative numbers calculated by transportation modelling (i.e. gas consumption volume)
6) Projection of indicative numbers calculated using results of transportation modelling (i.e. CO2 emission)
7) Projection of indicative numbers and images generated from GIS data (i.e. slope gradient map)
8) Use of statistical numbers that shall be continuously published by Government of DRC (i.e. number of death by particular causes)
9) Projection of indicative numbers generated from surveys such as reading of satellite photos (i.e. number of communities that may be split by proposed new roads)

CHAPTER 4 Existing Development Visions, Policies and Plans

4.1 National Development Vision and Policy (PNSD)

4.1.1 PNSD Objectives and Action Plans

The DRC (Democratic Republic of the Congo) government is in the process of finalizing the PNSD (*Plan National Stratégique de Développement* / National Strategic Development Plan, which was financially supported by UNDP) for 2017 to 2021, the national vision for economic development by 2030. The government previously formulated the DSRP (*Documents de Stratégie pour la Réduction de la Pauvreté* / Poverty Reduction Strategy Paper) for 2002 to 2005, the DSCRP-1 (*Document de la Stratégie de Croissance et de Réduction de la Pauvreté* / Growth and Poverty Reduction Strategy Paper) for 2006 to 2010, and the DSCRP-2 and the PAG (*Programme d'Appui à la Gouvernance* / Governance Support Programme) for 2011 to 2016. The PNSD 2017-2021 will be positioned as the national plan to follow up on the DSCRP-2 and PAG. The plans focused on stabilization, reconstruction and governance, and emphasized the importance of macroeconomic growth to accelerate employment. The main objectives of the three development plans are summarized in the following table.

Table 4.1.1 National Development Plans and Objectives

(2002-2005) DSRP	(2006-2010) DSCRP-1	(2011-2016) DSCRP-2 & PAG
• Stabilization, transition and reconstruction • Three strategic pillars: 1. Restoration and consolidation of peace 2. Macroeconomic stabilization 3. Community dynamics	• Governance and the revival of pro-poor growth • Five strategic pillars: 1. Good governance, peace and institutional building 2. Macroeconomic stability and growth 3. Access to social services and reduction of vulnerability 4. Fighting HIV/AIDS 5. Community dynamics	• Growth, employment creation and climate change impact • Four strategic pillars: 1. Governance and peace 2. Economic diversification growth acceleration and employment creation 3. Improve access to basic social services and human capital 4. Environment and climate change

Source: PNSD

To follow up on existing development plans, the pillars of the PNSD 2017-2021 will be: 1) Internalization of a new form of governance which implies a change of attitudes; 2) Economic diversification and improvement of competitiveness; 3) Improving human development and social protection; and 4) Fighting against climate change and strengthening environmental sustainability.

To achieve the goal of high economic growth, the PNSD will set economic indicator targets and action plans for the primary, secondary, and tertiary sectors as shown in Table 4.1.2.

Table 4.1.2 Economic Target and Action Plan by Sector

Economic Target	Action Plan by Sector
• Achieve the status of middle-income country by 2021, reaching USD 1,050 GDP per capita. • Achieve the status of emerging country by 2030, reaching USD 4,000 GDP per capita. • Join the club of developed countries by 2050, bringing the GDP per capita to USD 12,000.	• (Primary) Agricultural transformation. Increase agricultural productivity, and develop PAIs (Agro-Industrial Parks) and CDIs (Integrated Development Centres) to attract capital investment in the agriculture sector. • (Secondary) Intensive industrialization of the country. Create more locally added value and develop vertical and horizontal relationships. Establish PIs (Industrial Parks). • (Tertiary) Build a knowledge society by investing in human capital accumulation and research & development. Build a set of PSTs (Science and Technology Parks).

Source: PNSD

4.1.2 National Perspective Study (NPS)

NPS (The National Perspective Study), a long term development scenario for the DRC, is currently underway to help review the PNSD. A series of meetings and workshops will be organised to validate the work, coordinated by the Macroeconomic Studies Directorate of the Ministry of Planning with the support of AfDB (the African Development Bank). A final NPS document will be submitted to the parliament for its adoption. The scenarios included in the study can be summarised as shown below:

(1) Time Period

The time horizon of the development scenario is 25 years from 2016 to 2040.

(2) Approaches

A simulation of the DRC's long-term development includes the following approaches:

a. Systematically and comprehensively assess the growth and job creation potential of different sectors
b. Realistically highlight the potential of each sector identified for the benefit of the Congolese people
c. Identify and seize opportunities to multiply production capacity and deepen value chains for each sector, through the integration of technologies, informal and regional or global collaboration

(3) Three Development Scenarios.

Three possible development scenarios are summarized as follows:

a. Conservative Scenario - The current pace of development is maintained, and the target of achieving emerging country status by 2030 will not be reached.
b. Realistic Scenario - Reforming the economy in the agriculture and industrial sectors is necessary to boost development.
c. Optimistic Scenario - Optimal potential for development is realized and full employment reached.

Research on these three development scenarios is currently underway, and quantitative analysis is expected to be conducted to set definitive economic targets.

4.2 National Integrated Transport Development Plan (PDNIT)

PDNIT (*Le Plan Directeur National Intégré des Transports* / National Integrated Transport Master Plan) is being formulated by the CI by contracting the joint venture of Louis Berger and SYSTRA with finance from AfDB. The PDNIT prepared an integrated national transport master plan for the whole of DRC.

The Project has three phases; Phase 1, analysis of transport integration (data collection and analysis); Phase 2, proposal and choice of actions; and, Phase 3, development of the master plan and sectoral policy of transports. The results of Phase 3 of PDNIT were presented in April 2018 inviting relevant government agencies and development partners. CI has approved the reports of the PDNIT from July – September, 2018, and the report has been submitted to MITPR as of March 2019.

The PDNIT study has national and urban components. The urban component has a part for overall policy on urban transport sector for top fifteen large cities with more than 300,000 inhabitants, studies on urbanized area of Kinshasa, and case studies on four cities, Lubumbashi, Kisangani, Bukavu and Matadi, which are representing Congolese urban areas.

While the Study Area for Kinshasa City of PDNIT is not clearly described in the reports, only the current urbanized area was studied according to the interview to the PDNIT study team. The Study Area of the PDNIT as well as proposed road and public transport network toward 2040 is shown in Figure 4.2.1 and Figure 4.2.2. The planning horizon of the PDNIT for Kinshasa City is generally 2030 and 2040; while the first period is divided in to three parts: 2018-2020, 2021-2025 and 2026-2030.

Five urban transport sector issues are identified by the PDNIT. These are:

- Insufficient supply of urban infrastructure to be restructured, maintained and developed;
- Sub-standard public transport services to be structured and reinforced;
- Current unsatisfied and constrained travel demand to be served by transport modes;
- Inefficient transport organizations to be restructured in line with urban development; and
- Governance dysfunction requiring more local and more integrated management of transport.

Two types of objectives, strategic and operational, have been set. The six strategic objectives are:

- Respond to travel demand of rapidly growing urban populations through the provision of infrastructure and services;
- Develop urban transport systems which support sustainable and integrated urban development;
- Improve accessibility to employment and public services and increase social and territorial

inclusion;

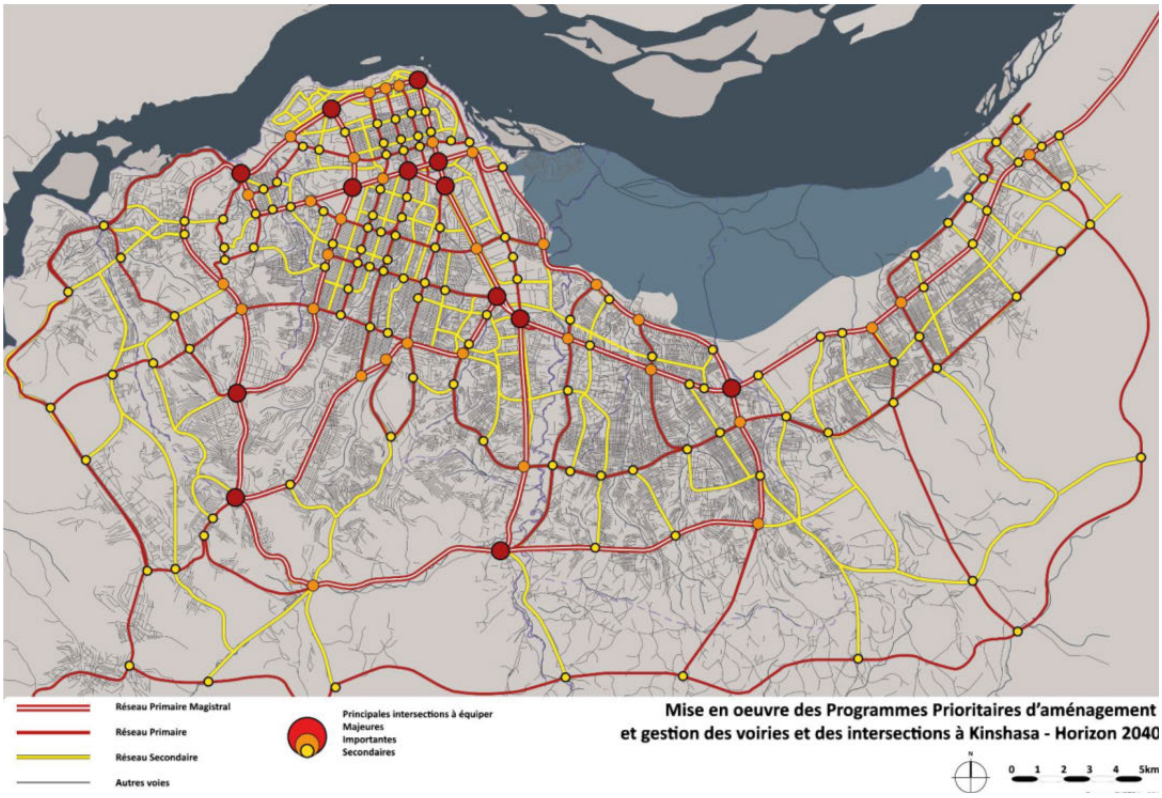
- Improve urban mobility under a controlled environmental and carbon footprint;
- Strengthen institutional, legal and regulatory frameworks for urban transport in order to include mobility as a key factor in decision-making processes; and,
- Formulate urban transport policy consistent with national level policy considering the specific needs of each city.

The eight operational objectives of the PDNIT are:

- Prioritize, restructure and complete the urban road network in order to improve reliability and support urban development;
- Reinforce maintenance of urban roads to be served;
- Strengthen the capacity of traffic flow management in order to smooth traffic and optimize network usage;
- Structure supply of urban feeder public transport services by supporting drivers and owners;
- Reinforce or create an urban public transport system for local needs and contexts;
- Organize multi-modal transport hubs (or "*Les pôles d'échanges*") to be integrated into the urban environment;
- Provide urban planning and project implementation tools; and
- Organize key persons to enable them to effectively implement urban transport policy.

In terms of urban transport system in Kinshasa City, several programs have been proposed such as development and maintenance of urban roads, improvement and management of intersections, multi-modal transport hubs (or "*Les pôles d'échanges*"), and public transport network development, including buses and BRT.

The PDNIT road network plan toward 2040 in Kinshasa City is shown in Figure 4.2.1. For the urban road sector, it is proposed to develop 500 km of road network and 90 intersections to form a grid road system in urbanized areas by 2030. The 2040 road network concept is based on the SOSAK (*Schéma d'Orientation Stratégique de l'Agglomération de Kinshasa* / Strategic Orientation Scheme for the Kinshasa Metropolitan Area) long term vision. Toward 2040, PDNIT proposed to develop 3,500km of road network and 220 intersections. Several bypass roads are also proposed in suburban areas.

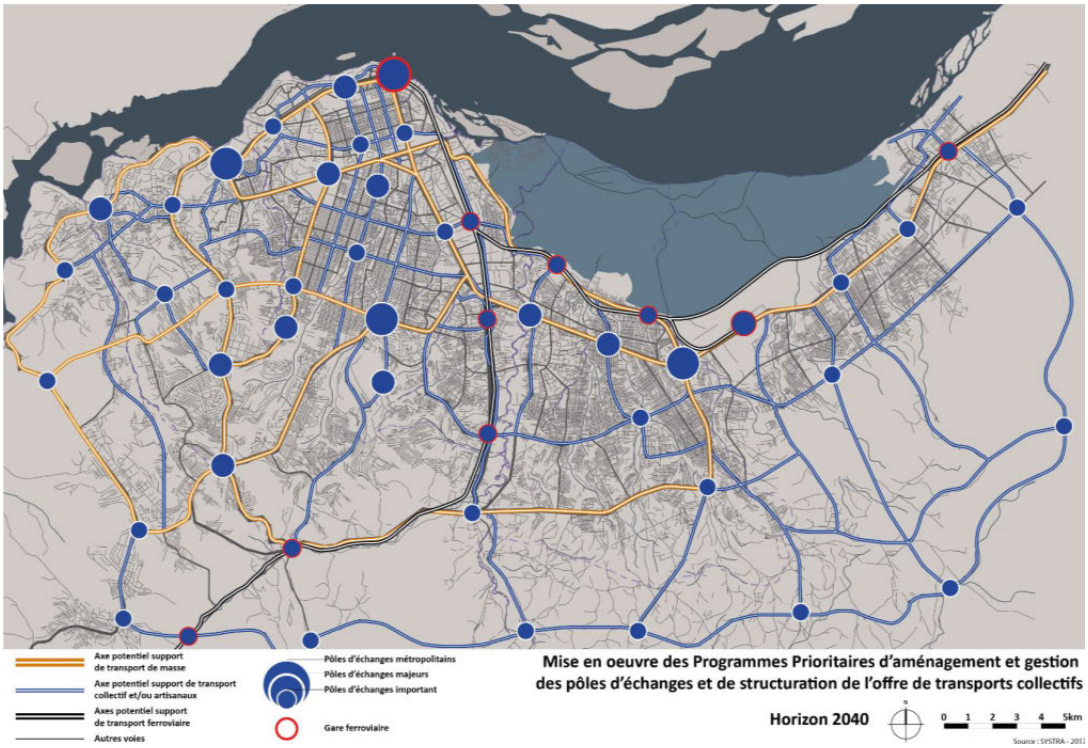


Source: PDNIT 2017 by Systra

Figure 4.2.1 Proposed Road Network and Intersection Improvement for Kinshasa City in 2040 by PDNIT

With regard to the public transport network in 2030, BRT routes are proposed for Lumumba Boulevard, Sendwe Boulevard, Triomphal Boulevard, 24 Novembre Avenue and 30 Juin Boulevard. For other primary and secondary routes, rehabilitation of buses and minibuses are proposed. Renovation of the railway line currently operating from the central station southward and the reopening of a railway line to the airport are proposed.

By the year 2040, several additional BRT routes are proposed as shown in Figure 4.2.2, while the railway network is almost the same as for 2030, but with an extension of the airport line to the northeast. Although the overall concept of the BRT network plan is in line with SOSAK, there are some differences, primarily in suburban areas.



Source: PDNIT 2017 by Systra

Figure 4.2.2 Proposed Public Transport Network and Multimodal Transport Hubs for Kinshasa City in 2040 by PDNIT

The estimated cost for proposed PDNIT priority projects for Kinshasa City between 2018 and 2030 is 2,648 million USD. Of this amount, 800 million USD would be for road development and rehabilitation, 290 million USD for road maintenance and operation, 18 million for development of multi-modal transport hubs (or "*Les pôles d'échanges*"), 140 million USD for intersection improvements, 950 million USD for railway renovation and reopening, 65 million USD for BRT and 380 million USD for other road-based public transport.

The PDTK and PDNIT studies were conducted almost simultaneously, although the PDNIT started a few months earlier, and the team members for both studies communicated with each other frequently to maintain consistency between the studies. It should also be mentioned that both studies are based on the SOSAK which was legally adopted by the provincial council. Therefore, the concepts of both studies are coherent in principle. For instance, the identification of current urban transport issues and policies are similar.

However, there are differences in the resolution of transport surveys and travel demand forecasts. For instance, large-scale commuter surveys and activity diary surveys in conjunction with more than 10 additional types of surveys were conducted for the Study to analyse the travel behaviour of respondents as described in Chapter 2. With approximately 400 traffic analysis zones covering the entire Study Area, a comprehensive quantitative travel demand model was developed for the evaluation of several transport network development scenarios. Thus, it is not surprising that there are minor differences in the project lists. Considering the level of detail in analysis of the Study, the PDNIT project list could be updated using the PDTK project list.

4.3 Urban Development Plan in Kinshasa City (SOSAK)

4.3.1 Urban Development Matters

The outline of the urban planning contents of SOSAK (*Schéma d'Orientation Stratégique de l'Agglomération de Kinshasa* / Strategic Orientation Scheme for the Kinshasa Metropolitan Area, which was financed by AfDB) and planning issues are as follows.

(1) Objectives and status of the plan

SOSAK states the following matters as the objectives for the fifteen years of the planning document.

- Provision of future economic and demographic situation
- Provision of economic development and spatial development
- To balance social environment with residents
- To define urban facilities and services

(2) Analysis on the current and historical urban situation

SOSAK takes following matters for analysis on the current urban situation with their historical background.

- Analysis of former urban planning

  SOSAK describes the details of following representative urban planning documents and analyses their planning objects and issues.

  - Schematic Plan of Rene Scoentjes (1933)
  - Regional Development Plan (1967)
  - Urban Development Projects (1985)
  - Series of large scale urban construction works (2007)

- Analysis on the former urbanization of Kinshasa City

  SOSAK analyses the characteristics of each commune with its development period and historical background. It classifies communes into six urban types and identifies their urban environmental situation and issues.

- Estimation of current population

  SOSAK estimates the population of Kinshasa City as of 2013 by referring to the statistics of INS (*Institut National des Statistiques* / National Statistical Institute) and calculated the number based on the registered number for elections. Based on these results, SOSAK estimates the following two cases for the population of 2013.

  - 10,558,000 (higher estimation, referring to INS statistics)
  - 8,300,000 (lower estimation by the consultant)

- Current situation of infrastructure facilities

SOSAK confirms the current network of infrastructure and analyses their issues. The actual situation of the sectors and distribution of the following facilities are investigated and described.

- Public facilities
- Medical facilities
- Public (commercial) market
- Water supply
- Power supply
- Drainage

(3) Future Development Planning

Based on the results of the current condition, SOSAK analyses the potentiality of future development and proposes development scenarios.

- Development concept

  SOSAK proposes eight development orientations for the future development of Kinshasa City.

  1. Expansion of the traffic network according to the extension of urban development
  2. Development of communal and multimodal transport
  3. Resolution of the congestion in the centre of the city and creation of other urban cores
  4. Planning with forecasting for extended urban areas
  5. Upgrading urban facilities in poorly equipped quarters
  6. Development of infrastructure and facilities
  7. Symbiosis with the natural environment
  8. Promotion of city as art and culture

- Estimation of the future population

  SOSAK estimates the future population based on the two different estimations of 2013 and assumes 3% as an annual increase ratio of the population.

- Forecast of the future development area

  SOSAK studies the candidate development areas mainly located in the surrounding area of the current urbanized area. It identifies eight candidate development zones in the surroundings of the current urbanized area in consideration of their geographical features.

- Forecast of the development scenarios and evaluation

  SOSAK prepares three different development scenarios and analyses their possibilities, advantages and disadvantages. It assumes the future development demand based on the assumption of 3% annual increase in the future population by the consultant.

- The following three scenarios are considered for evaluation.

  - Progress of urbanization between Mont-ngafula and N'sele (Scenario of the western side

prior to development)

- Progress of urbanization between Kimbanseke and Maluku (Scenario of the eastern side prior to development)
- Progress of urbanization between Mont-ngafula and Maluku (Scenario without development in plateau in Southern N'sele)

(4) Planning Issues of the Plan

The following issues of SOSAK are suggested to be reconsidered and reconfirmed for the PDTK (Projet d'élaboration du Plan directeur des transports urbains de la ville de Kinshasa / the Project for Urban Transport Master Plan in Kinshasa City) study due to the inconsistency with the current situation and the indefinite planning logic.

- Logic on the estimation of current and future population

  SOSAK does not define the estimated population in 2013 and the future. Although its main objective is to forecast the future urban area, it does not calculate the possible population numbers. It assumes 3% as the annual population increase ratio and estimates the corresponding urban expansion.

- Forecast of the future development demand

  As mentioned above, SOSAK studies candidate areas with 3% population increase annually. The Study Team assumes that the population and future development demand will be more than that of SOSAK. Therefore, the Study Team acknowledges the necessity of reconfirmation of future development demands and the corresponding development area.

- Forecast of Future Development Area

  SOSAK considers the following areas as candidates of development areas. The suitability for the future demands needs to be re-examined and the adequate development conditions need to be considered.

  - The development area in the south of N'sele commune: the candidate area is located at the plateau higher than 650 m altitude. The access is considered to be limited because of its steep geographical conditions.
  - The development area in Kimpoko, N'sele commune: the current land use of the area is agricultural area, which is precious in Kinshasa City. For the consideration of development of these areas, it is necessary to harmonize the agricultural activities with development.

- Assessment of the Future Transport networks

  SOSAK planned the two east-west roads in addition to the current N1 and the Study basically agrees with that plan. The Study recognizes the importance of the two new roads, but acknowledges the difficulty of land acquisition to accommodate the road planned especially at the immediate south of the existing N1 road, since it inevitably passes through the built-up area of the N'djili Commune and Kimbanseke Commune.

- Distribution of Future Urban function

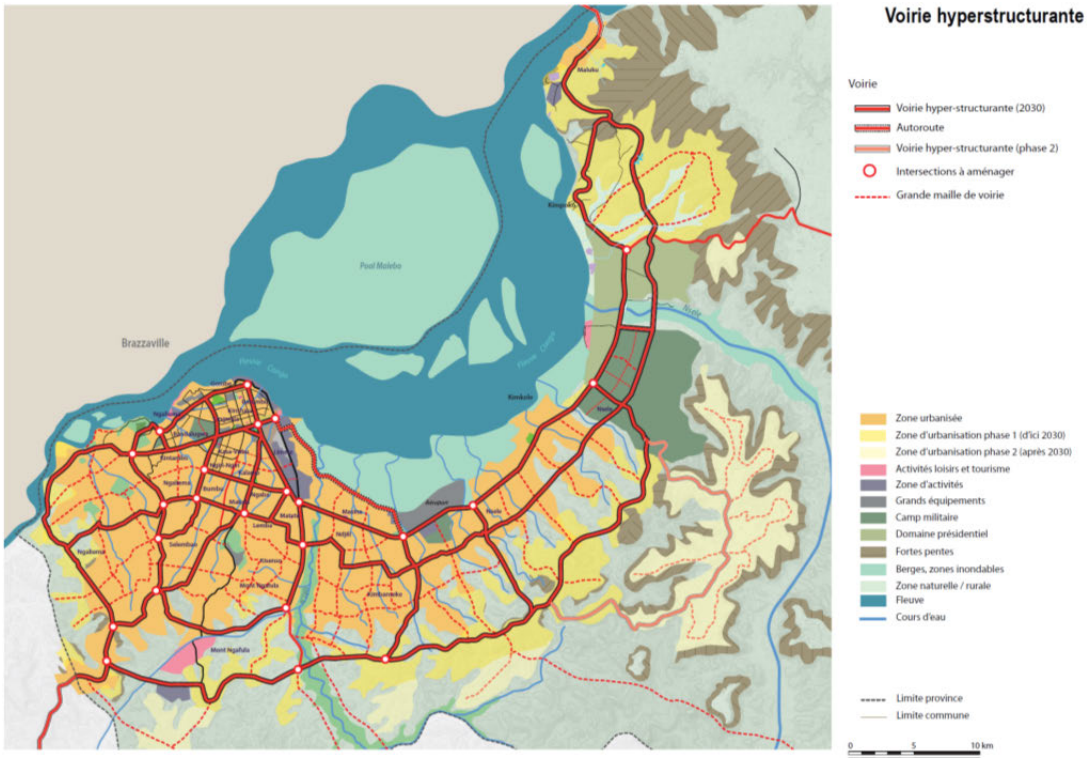
  As the result of the above mentioned matters, the Study suggests the re-examination of the balance of the estimated population and the development capacity of the proposed plans. The

Study supposed that it is necessary to prepare more distributed urban cores in order to resolve the assumed situation of over-concentration in future.

4.3.2 Transport Sector

Transport sector of SOSAK refers to the "Urban Transport Study of Kinshasa" (*Etude du Plan de mobilité de Kinshasa*) prepared by Transurb Technirail, STRATEC and A.E.C funded by the Belgian Development Agency, CTB (*Coopération Technique Belge, Agence Belge de Développement / Belgian Technical Cooperation, Belgian Development Agency*) and the "Technical Report of Mission on Urban Transport" (*Mission d'expertise sur la mobilité urbaine à Kinshasa, Rapport Technique*) funded by the World Bank. The proposal of the SOSAK is based on those studies.

The proposed urban road network by SOSAK is show in Figure 4.3.1. In principle, an urban road network is planned to form a mesh of 2km considering the accessibility to the arterial roads assuming that every resident in urban areas can access to arterial roads with 1km of walking or approximately fifteen minutes of walking. Based on this urban road network, several primary arterial roads (*Voirie hyper-structurante*) are proposed to connect the city centre, industrial areas, universities, airports and river ports. These primary arterial roads includes the roads in the city centre to form a grid, ring roads, and two roads to Maluku which are connecting to the proposed bridge to the Republic of Congo. The total length of this road network is 604km, and, it is estimated that it costs 3.69 billion USD to be paid until 2030. In addition, 131km of roads which requires 0.42 billion USD is proposed.

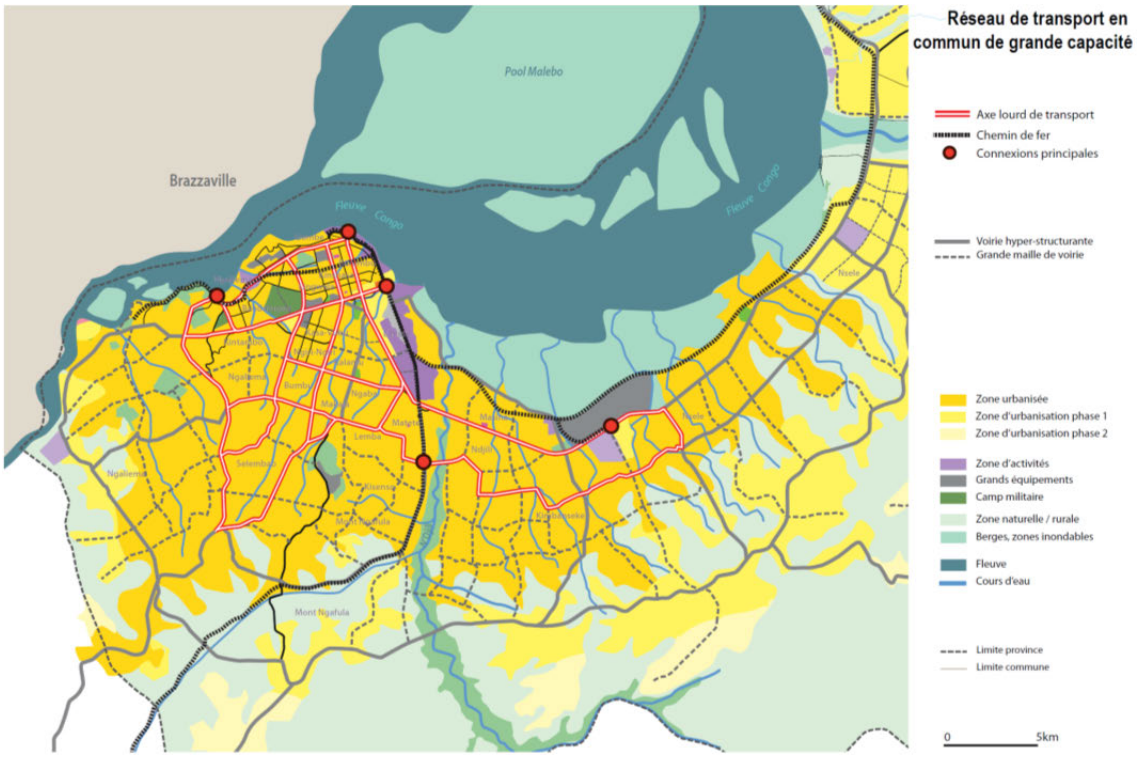


Source: SOSAK

Figure 4.3.1 Arterial Road Network Proposed by SOSAK

In terms of public transport, railway is expected to serve as trunk routes. The existing and abandoned lines to/from Kintambo, Airport and Kimwenza are planned to be modernised. The total length of modernization is 64.1km. The cost for modernization is estimated at 0.54 billion USD. However, there is no plan of additional railway line.

A BRT (Bus Rapid Transit) system is also proposed along arterial roads taking financial constraint into consideration for the short term option. It is also mentioned that it can be converted to a LRT (Light Rail Transit) in the future. The public transport network is shown in Figure 4.3.2.



Source: SOSAK

Figure 4.3.2 Public Transport Network Proposed by SOSAK

In addition to infrastructure development, SOSAK also analysed institutional aspects. It proposed a multi-sector organization for urban development called "Urban Development Unit" (*Cellule de Développement Urbain*) for the purpose of coordination and study of cross-sector issues. In addition, an urban development authority (*Société d'Aménagement à Kinshasa* / *SEMAKIN*) is proposed as a project implementing body under the central government.

The AOTU (*Autorité Organisatrice des Transports Urbains* / Urban Transport Authority) which is in charge of the entire urban transport of Kinshasa is also proposed by SOSAK.

SOSAK acknowledged that further analysis is required for the transport sector. The draft terms of reference of the following three studies are attached as appendices.

- Feasibility study of bus rapid transit system
- Study on traffic flow analysis and traffic management in the city centre
- Study on the establishment of AOTU

Although the SOSAK covers the entire urban development sector, it does not cover all the aspects of urban transport. The following points require further analysis.

- Quantitative analysis on transport demand based on transport surveys
- Economic benefits and congestion mitigation impact of proposed road networks
- Selection of corridors and modes of trunk public transport systems based on future transport demand
- Management of existing buses and taxies
- TDM (Transport Demand Management)

4.4 Review of Previous Transport Studies

The latest two studies in 2011 and 2013 which are also referred in the SOSAK are reviewed below.

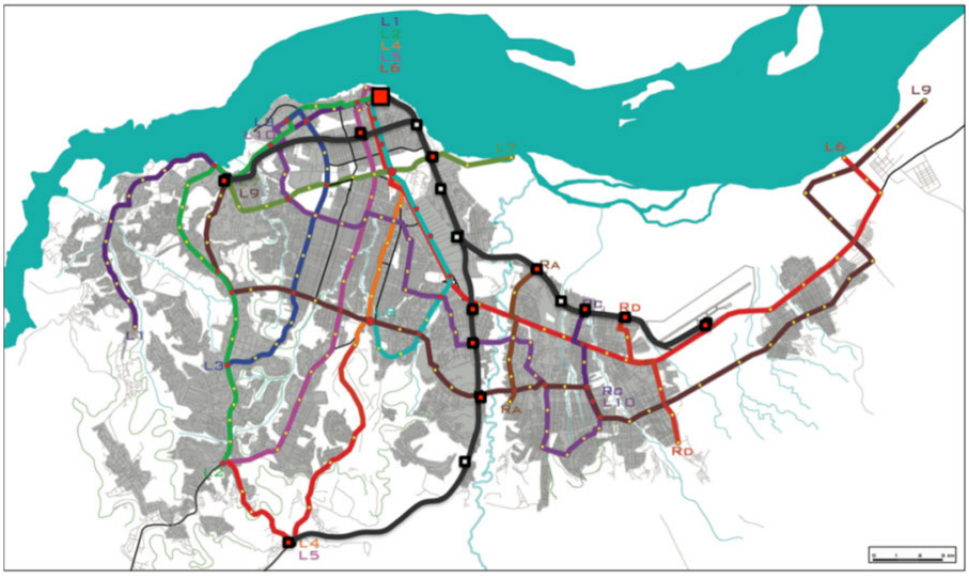
4.4.1 Urban Transport Study of Kinshasa (CTB, 2011)

A summary of projects proposed in the Urban Transport Study (*Etude du Plan de Mobilité de Kinshasa*) financed by the Belgian Development Agency, BTC (*Agence Belge de Développement*, *CTB*) in 2011 are shown in Table 4.4.1 and exhibited in Figure 4.4.1 and Figure 4.4.2 .

Table 4.4.1 Summary of Projects Proposed by Urban Transport Study of Kinshasa City, 2011

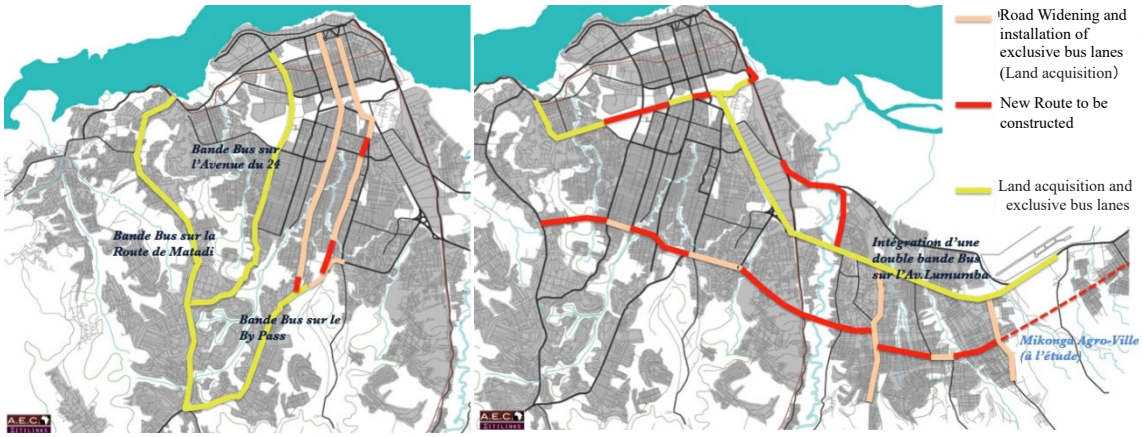
Project	Area	Contents
BRT	Urbanized Area of Kinshasa City	・ 7 circular routes ・ Bypass and 3 longitudinal lines (Line 7, 9 and 10A) ・ 4 routes as railway feeder service (Line Ra, Rc, Rd, 10B) ・ Total length of routes is 247 km ・ Total estimated cost is 820 million Euros
Railway Modernization		・ Improvement and track and station development of ONATRA (current SCTP) ・ Total length of lines are approximately 70km ・ Total estimated cost is 260 million Euros
Road Network Development	North-South Radial Roads ・ Elengesa Avenue ・ Kimwenza Avenue ・ Matadi Route ・ 24 Avenue ・ By Pass	・ Road widening and installation of exclusive lanes for BRT ・ Extension and improvement of Elengesa Avenue: 8.2km, 36 million Euros ・ Extension and improvement of Kimwenza Avenue: 6.3km, 28 million Euros ・ Road widening for BRT: Matadi Route, 24 Avenue and By Pass
	East-West Roads ・ Lumumba Avenue ・ Mikonga Agro-Ville	・ Road widening and installation of exclusive lanes for BRT ・ Improvement and construction of the central ring bypass (road from Kintambo Magasin to N'dolo via Kasavubu Avenue) ・ Ngaba Connection Road: road from the bypass to Mont Ngaliema via Route de Matadi (6.2km, 47 million Euros including Molwa bridge and Manifesto bridge) ・ N'djili－Kimbanseke Connection Road: the road connecting N'djili and Kimbanseke crossing N'djili River is expected to reduce the traffic of Lumumba Avenue: 6.2 km 95 million Euros including improvement of 4 intersections ・ Removal of Bottlenecks of N'djili: N'djili detour routes along Petro Congo for the reduction of traffic on Lumumba Avenue including the access road to Masina railway station

Source: l'Etude du Plan de Mobilité de Kinshasa, Final Report Phase 3, BTC, 2011



Source: l'Etude du Plan de Mobilité de Kinshasa, Final Report Phase 3, BTC, 2011

Figure 4.4.1 Long-Term Network Plan of Public Transport



Source: l'Etude du Plan de Mobilité de Kinshasa, Final Report Phase 3, CTB, 2011
Note: The left figure is on the north-south radial road network development plan.
The right figure is east-west road network development plan

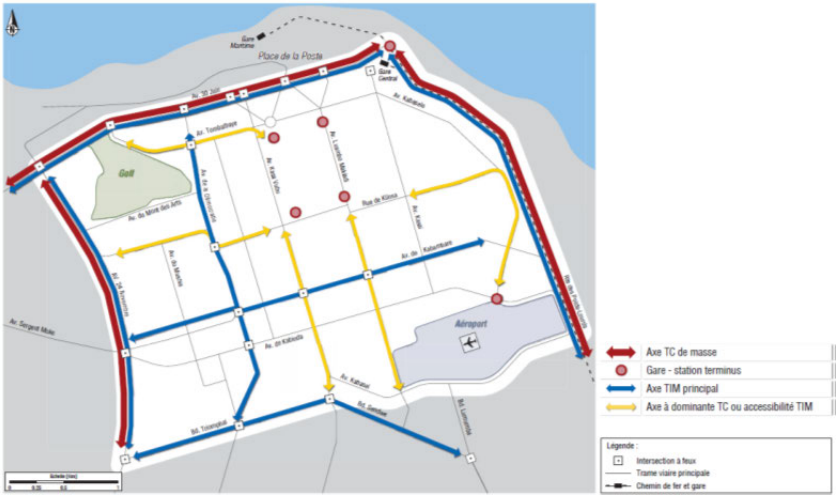
Figure 4.4.2 Road Network Development Plan

4.4.2 Technical Report of Mission on Urban Transport (World Bank, 2013)

The World Bank prepared the "Technical Report of Mission on Urban Transport" (*Mission d'expertise sur la mobilité urbaine à Kinshasa, Rapport Technique*) in 2013. The report proposed "multi-modal vision 2025" (*Esquisse d'une vision multimodale à 2025*) with five components.

- Strengthening the Road Network as a Short Term Projects
- Re-arrangement of Public Transport
- Securing Safety for Walkers and Promoting Walking
- Implementation of Urban Transport Plans
- Institutional Development and Finance

One of the proposed plans for the traffic flow management is presented in Figure 4.4.3.



Source: Mission d'expertise sur la mobilité urbaine à Kinshasa, Rapport technique, World Bank, 2013

Figure 4.4.3 Improvement of Traffic Flow Management in the City Centre