



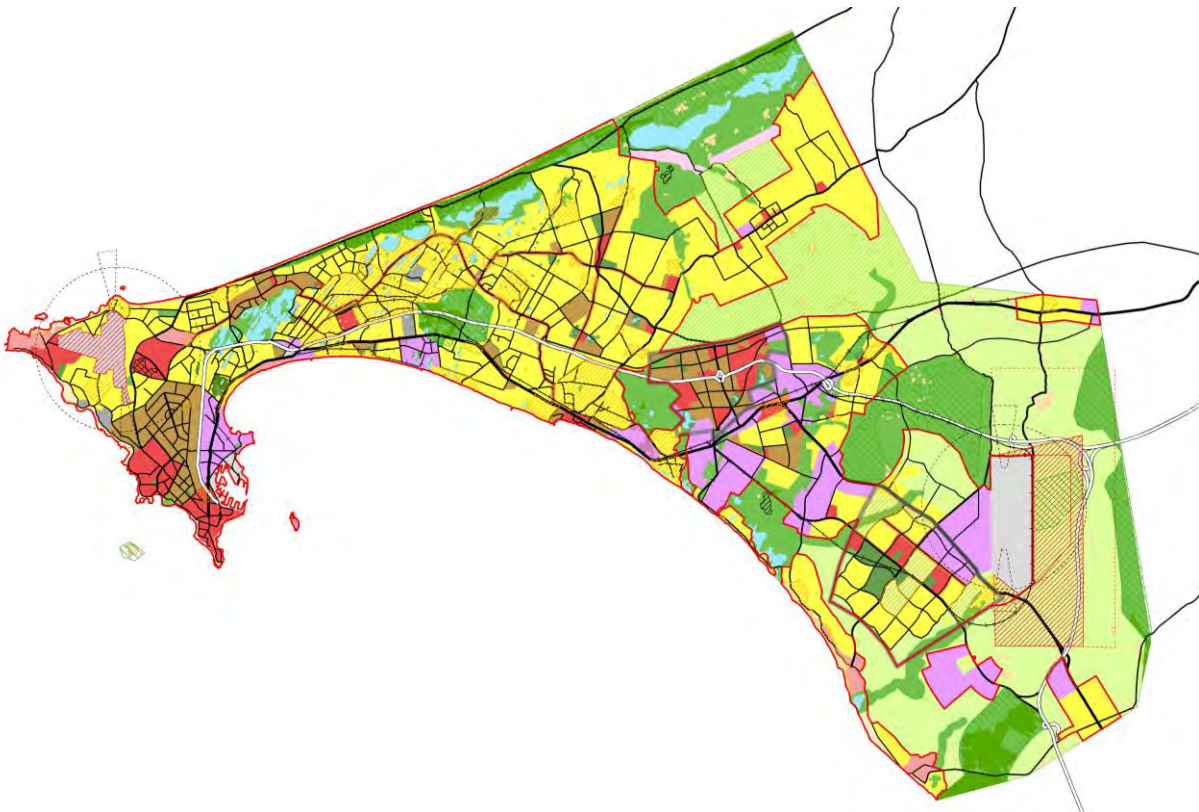
**Ministry of Urban Renewal,
Housing and Living Environment
Republic of Senegal**



**Japan International Cooperation
Agency (JICA)**

Project for Urban Master Plan of Dakar and Neighboring Area for 2035

Final Report Summary



January 2016

**Implemented by:
RECS International Inc.
Oriental Consultants Global Co., Ltd.
PACET Corp.
CTI Engineering International Co., Ltd.
Asia Air Survey Co., Ltd.**

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Currency equivalents (average Interbank rates between May and July, 2015):
US \$1.00 = FCFA 594.04
€1.00 = FCFA 659.95
Source: Banque Centrale des Etats de l'Afrique de l'Ouest (BCEAO) rate

Outline of the Project

Title	<ul style="list-style-type: none"> • Project for Urban Master Plan of Dakar and Neighboring Area for 2035 (commonly used) • Project for Updating the Dakar Urbanization Master Plan 2025 (determined in the Record of Discussion)
Duration	16 months from August 2014 until January 2016
Responsible organizations	<ul style="list-style-type: none"> • Department of Urbanization and Architecture (DUA), Ministry of Urban Renewal, Housing and Living Environment (Senegal) • Japan International Cooperation Agency (Japan) • Consortium of RECS International Inc. Oriental Consultants Co., Ltd., PACET Corp. CTI Engineering International Co., Ltd., Asia Air Survey Co., Ltd. (implementation)
Areas covered	Sustainability diagnosis, urban planning, land use planning, geographic information system (GIS), strategic environmental assessment, capacity development planning, socioeconomic analysis and planning, sector planning in transportation, water resources, water supply, sewerage, solid waste management, electricity and renewable energy, urban disaster including flood, industrial development, economic analysis, topographic map preparation and cost estimate
Target area	About 820 km ² covering the entire Dakar region and part of Thiès region
Objectives	<ul style="list-style-type: none"> • To prepare an urban development master plan for the target year of 2035 • To prepare a detail plan for a selected area • To conduct a pre-feasibility study for priority projects (no more than three) • To promote capacity development of the DUA
Existing condition and problems	<ul style="list-style-type: none"> • Dakar's population grew rapidly from 1,488 thousand in 1988 to 3,137 thousand in 2013, caused by the massive influx of a rural population escaping from droughts into Dakar as well as a natural increase in the birth rate. Much of the population is now living in unplanned flood-prone areas in Pikine and Guidiawaye, which are not suitable for habitation because they suffer from flooding in the rainy season and a lack of urban infrastructure services. • The monopolar urban structure results in the excessive concentration of commercial and business activities in the Plateau, which is causing chronic heavy traffic congestion and placing an excessive burden on urban infrastructures. Infrastructural services are not able to accommodate increasing demands. • The Senegalese government has not been able to tackle these issues swiftly and effectively due to its technical and financial constraints. • While the main idea behind the ongoing 2025 Master Plan is to transform the monopolar urban structure to a multipolar structure by encouraging growth in the seven urban poles, development is progressing only in Diamniadio. Moreover, urbanization has been encouraged, which encroaches onto farm and other environmentally sensitive areas, especially Nyaye. • The Senegalese government has not been able to tackle these issues swiftly and effectively due to its technical and financial constraints.
Proposed outputs	<ul style="list-style-type: none"> • A "City of Hospitality" is proposed as the vision for 2035. • Sustainability enhancement strategies are proposed under seven objectives: <i>comfortable environment creation, smooth communication promotion, innovative creation promotion, urban management, environment management, inclusiveness enhancement and broad view application.</i> • The land use plan for 2035 proposes to transform the present monopolar urban structure to a multipolar one by establishing new urban poles in Daga Kholpa and Diamniadio. They will grow as self-contained, compact urban areas surrounded by green areas and farm lands, linked efficiently with each other and with other urban centers. • Daga Kholpa will grow as an urban pole taking advantage of its proximity to the new airport and its status as part of the special economic zone. A population of about 190 thousand will live in the Daga Kholpa project area, which covers 3,891 hectares. Its land use is characterized by coexistence of the existing villages and modern urban areas alongside a green zone allocated to the flood-prone area. • Two priority projects - <i>Intersection Improvement Project on the VDN and the Front de Terre Road</i> and <i>Traffic Improvement Project Around Baux Maraichers Bus Terminal</i> - are recommended for implementation. A comparative analysis of the optimum solid waste management method clarified the potential of waste-to-energy system.

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Abbreviations

AGERROUTE	Agency for Road Construction and Management	AGERROUTE	Agence des Travaux et de Gestion des Routes
AIBD	Blaise Diagne International Airport	AIBD	Aéroport International Blaise Diagne
APIX	National Agency in charge of Investment Promotion and Major Works	APIX	Agence Nationale Chargée de la Promotion de l'Investissement et des Grands Travaux
BRT	Bus Rapid Transit	BRT	BRT (Service Rapide par Bus)
CADAK-CA	Community of Dakar and Rufisque	CADAK-CA	Communauté des Agglomérations de Rufisque et de Dakar
R	Agglomerations	R	
CBD	Central Business District	CBD	
CETUD	Executive Council of Urban Transport in Dakar	CETUD	Conseil Exécutif des Transports Urbains de Dakar
DDD	Dakar Dem Dik	DDD	Dakar Dem Dik
DEEC	Department of Environment and Classified Establishments	DEEC	Direction de l'Environnement et des Établissements Classés
DPEE	Direction Of The Forecast and Economic Studies	DPEE	Direction de la Prévision et des Etudes Economiques
DUA	Department of Urbanization and Architecture	DUA	Direction de l'Urbanisme et de l'Architecture
ECOWAS	Economic Community Of West African States	CEDEAO	Communauté Economique des Etats de l'Afrique de l'Ouest
EIRR	Economic Internal Rate of Return	TRIE	Taux de Rentabilité Interne Economique
GHG	Green House Gas	GES	Emissions de Gaz à Effet de Serre
GIS	Geographic Information System	SIG	Système d'Information Géographique
GRDP	Gross Regional Domestic Product	GRDP	Produit Intérieur Brut Régional
ICT	Information and Communications Technology	TIC	Technologie de l'Information et de la Communication
IPP	Independent Power Producer	IPP	Producteur d'Electricité Indépendant
JICA	Japan International Cooperation Agency	JICA	Agence Japonaise de Coopération Internationale
KMS	Keur Momar Sarr	KMS	Keur Momar Sarr
LPI	Logistic Performance Index	LPI	Indice de Performance Logistique
NRW	Non-Revenue Water	NRW	Eaux non facturées
OECD	Organization for Economic Cooperation and Development	OCDE	Organisation de Coopération et de Développement Economiques
PCU	Passenger Car Units	UVP	Unité de Voiture Particulière
PDA	Drainage and sewerage master plan for Dakar	PDA	Plan Directeur d'Assainissement Liquide de Dakar
PDU	Urban Planning Master Plan	PDU	Plan Directeur d'Urbanisme
PDUD	Dakar Agglomeration Urban Displacement Plan	PDUD	Plan de déplacements urbains de Dakar
PGAT	General Plan for National Territory	PGAT	Plan Général d'Aménagement du Territoire
PNAT	General Plan for National Territory	PNAT	Plan Général d'Aménagement du Territoire
PROGEP	Storm Water Management and Climate Change Adaptation Project	PROGEP	Projet de Gestion des Eaux Pluviales et d'adaptation au changement climatique
PSE	Senegal Emergence Plan	PSE	Plan Sénégal Emergent
PTB	Blue Line of Railway	PTB	Petit Train de Banlieue
PUD	Detailed Urban Plan	PUD	Plans d'Urbanisme de Détails
RD	Record of Discussion	RD	Compte Rendu de discussions
RE	Land Consolidation	RE	Remembrement
RU	Urban Renewal	RU	Rénovation Urbaine
SDAU	Master Plan for Urban Planning and Development	SDAU	Schéma Directeur d'Aménagement et d'Urbanisme
SDE	Senegalese Water Company	SDE	Sénégalaise des Eaux
SEA	Strategic Environmental Assessment	EES	Évaluation Environnementale Stratégique
SENELEC	National Electricity Corporation of Senegal	SENELEC	Société Nationale d'Electricité du Sénégal
SEZ	Special Economic Zone	ZES	Zone Economique Spéciale
SME	Small and medium sized enterprises	PME	Petites et Moyennes Entreprises
SONES	National Water Company of Senegal	SONES	Société Nationale des Eaux du Sénégal
STP	Sewage Treatment Plant	STP	Station de Traitement des Eaux Usées
TER	Regional Express Train	TER	Train Express Régional
TOD	Transit-Oriented Development	DATP	Développement Axé sur le Transport Public
TVET	Technical and Vocational Education and Training	EFTP	Enseignement et Formation Techniques et Professionnels
UCA	Urban Control Area	ZCU	Zone de Contrôle Urbain
UEMOA	West African Economic and Monetary Union	UEMOA	Union Economique et Monétaire Ouest Africaine
UGB	Urban Growth Boundary	LCU	Limite de Croissance Urbaine
UNICEF	United Nations Children's Fund	UNICEF	Fonds des Nations unies pour l'enfance
UPA	Urban Promotion Area	ZPU	Zone de Croissance Urbaine
VDN	North Bypass Road	VDN	Voie de Dégagement Nord
WB	World Bank	BM	Banque mondiale
ZAC	Cooperative Development Zone	ZAC	Zones d'Aménagement Concerté

Unit of Measurement

Area		Time	
m ²	square meter	sec, s	second
km ²	square kilometer	min	minute
ha	hectare (= 10,000 m ²)	h, hr	hour
		d	day
		y	year
Length		Energy	
mm	millimeter	W	watt
cm	centimeter	kW	kilowatt
m	meter	kWh	kilowatt-hour
km	kilometer	MW	megawatt
		GWh	gigawatt-hour
Weight		cal	calorie
µg	micro gram	J	joules (=4,18 cal)
mg	milligram	kJ	kilo Joules
kg	kilogram		
t	ton (=1,000 kg)	Other	
MT	metric ton	%	percent
kt	kilo ton	ppm	parts per million
Volume		degree	degree Celsius
l	liter	cap	capita
m ³	cubic meter (= 1,000 liter)	dB	decibel
MCM	million cubic meter	mil.	million
BCM	billion cubic meter	TEU	Twenty-Foot Equivalent Unit

Currency

JPY	Japanese Yen
FCFA	CFA Franc
€	Euro
US\$	United States Dollar
Intl\$	International dollar

CHAPTER 1 INTRODUCTION

1.1 Background

The government of Senegal requested the government of Japan to extend technical cooperation in revising the Dakar Urban Master Plan 2025. After a series of discussions, the Japan International Cooperation Agency (JICA), which is the executive arm of the Japanese government for technical and financial cooperation, and the government of Senegal agreed and signed a record of discussion (RD) on the Project for Upgrading the Dakar Urban Master Plan 2025 (“the Study” hereafter) on May 5, 2014 in Dakar. The JICA brought together a consortium of consultants (“the JICA Study Team” hereafter) headed by RECS International Inc. in order to execute the Study.

1.2 Objectives

The objectives of the Study are the following:

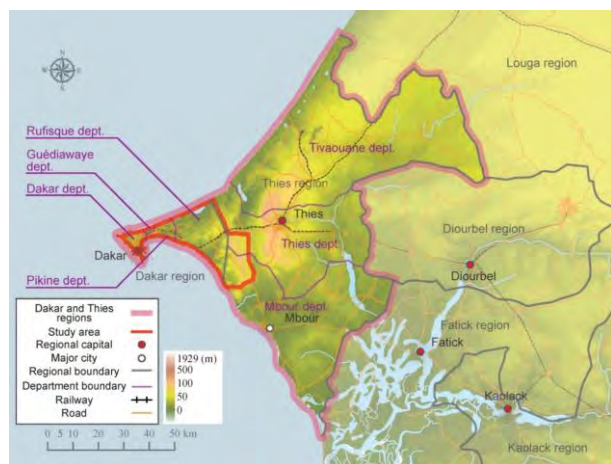
- To prepare an urban development master plan for the Dakar Region and its neighboring area for the target year of 2035 (“2035 Master Plan” hereafter)
- To prepare a detailed plan for at least one selected area as a tool to realize the 2035 Master Plan
- To conduct pre-feasibility studies on priority projects also to be selected as a tool to realize the 2035 Master Plan
- To undertake capacity development for the Department of Urbanization and Architecture (DUA), related ministries, organizations and local government in order to strengthen their staff capabilities so that they will be able to properly manage urban development

1.3 Study Area

The Study’s target area (“the Study Area” hereafter) is the Dakar region and the area surrounding the Blaise Diagne International Airport in the Thiès region, which is an area of about 820 km², as shown in Figure 1.1.

1.4 Final Report

The final report presents all the findings and proposals of the Study conducted between August 2014 and January 2016. It consists of three volumes: Volumes I and II include the main text, while Volume III, which is in a compact disc format, comprises appendices including surveys and supporting data. A detailed plan guideline and a pamphlet summarizing the results of the Study are prepared and submitted separately.



Source: JICA Study Team

Figure 1.1 Location of the Study Area

CHAPTER 2 MAJOR DEVELOPMENT ISSUES

2.1 Development Issues by Sector

The following major development issues were clarified for each sector:

Natural Environment

- Green areas, farmlands and wetlands are decreasing as a result of a rapid population increase and uncontrolled urbanization.
- The quality of air, water and soil are degrading as a result of accelerated motorization, inadequate enforcement of laws and delays in developing environment-related infrastructures, such as solid waste management facilities and sewerage facilities.

Urban Development

- Uncontrolled development has been taking place as a result of rapid population growth and the inadequate capacity of government to manage land development by preparing and implementing urban plans in a timely manner.
- Urban disaster risks are increasing as a result of the expansion of housing areas into areas unsuitable for development, such as flood-prone areas and areas adjacent to factories.
- A limited supply of affordable housing caused by the traditional land tenure system, an immature housing sector and the expansion of housing areas into unsuitable areas.
- Concentration of commercial and business activities on the Plateau results in an excessive burden on urban infrastructures and chronic traffic congestion during morning and evening peak hours.
- Disparity among areas and districts in the availability of urban services is expanding due to a rapid population increase as well the government's lack of budgeting, planning and implementation capability.

Economic Development

- The potential for urban agriculture is threatened by a decrease in farmlands caused by rapid and uncontrolled expansion of urban areas.
- Agricultural production is characterized by low productivity due to limited access to inputs and markets and a lack of irrigation water.
- The fisheries sector is facing a decrease in marine resources due to excessive fishing and the pollution of seawater by discharge of untreated industrial wastewater. Improper handling of the catch damages the quality of marine products and decreases its economic value.
- The industrial production is stagnant due to a lack of technological development, inadequate investment, delays in human resources development, a lack of cooperation between companies and high electricity prices.
- The production activities of the informal sector, which supplies a large proportion of goods, is inactive due to severe competition from imported goods, production using outdated equipment and low levels of technology.

- Tourism potential is not sufficiently exploited due to inadequate infrastructure facilities and services supporting tourism, limited recognition of Senegal as a tourist destination (especially by non-French people) and delays in developing tourism products.

Infrastructure

- Development of a public transportation system has been slow due to the priority placed on road development to cope with rapid motorization. The existing transportation system, which is centered on the road network, has not been able to expand its capacity to accommodate demand due to delays in expanding the capacity of road infrastructure, the slow introduction of modern systems and equipment, such as traffic signal control systems and traffic information systems, and rampant on-street parking resulting in frequent traffic congestion.
- Services provided by the existing public transport system is not able to meet people's needs due to inefficient operation by the informal sector, a lack of feeder bus services for the railway as well as line-haul bus services and a lack of an integrated tariff system for different transportation modes.
- Dakar Port is not able to keep up with the increasing demand for cargo handling due to a lack of facilities and an inefficient customs operation. Its burden is increasing because of delays in developing secondary ports in Senegal. Traffic congestion around Dakar Port is decreasing its operational efficiency. High port charges are constraining Dakar Port's capacity to become a major hub port in West Africa.
- Development of the logistics sector is hampered by an inadequate capacity of the Dakar Bamako Railway characterized by outdated facilities, inefficient operation and improper concession contracts, damaged roads due to a lack of proper maintenance and non-physical barriers, such as the existence of numerous checkpoints, harassment and informal payments.
- The water supply in the Study Area is dependent on a single external water resource, which is a fragile situation, while groundwater in the Study Area is decreasing. Conveyance of voluminous external water into the Study Area beyond the natural water cycle mechanism is causing degradation of groundwater quality.
- Degradation of water quality is proceeding due to delays in expanding the sewerage system, the inadequate treatment capacity of sewage treatment plants with old facilities, which often receive an amount of water beyond their treatment capacities, and the slow dissemination of sanitary toilets in non-sewered areas.
- The unsanitary condition is exacerbated by illegal dumping of domestic and construction waste, the limited coverage provided by the waste collection system and the unsanitary dumping of waste at the Mbeubeuss dumping site.
- An unstable electricity supply caused by outdated facilities and inadequate supply capacity as well as high electricity prices are constraining economic activities and improvements to living conditions. Support measures for renewable energy use are inadequate.
- There are constraints for the dissemination of non-structural measures to reduce urban risk, such as the limited capacity of the government to deal with emergency situations, the lack of awareness among the population about disaster risks and inadequate systems for information sharing and dissemination. The approach for integrating disaster risk management into land use planning is inadequate. There are residual risks of flooding in the PROGEP area in Pikine and Guediawye, while the newly urbanizing areas will also face flood risks unless advance measures are taken.

2.2 Sustainability Diagnosis

The concept of *sustainability* is becoming increasingly important in contemporary urban planning.

The United Nations (UN) defines “sustainable development” as follows: “*a sustainable society meets the needs of the present generation without sacrificing the ability of future generations to meet their own needs*”. It implies the importance of maintaining the global environment in a desirable condition, which is the very fundamental condition to ensure sustainability of society and cities. Paraphrasing the UN definition, the Study defines sustainable development as follows:

- “Sustainable” means development will continue for present and future generations by minimizing the load on the regional and global environment
- “Development” means that a state of improved quality of life is ensured

Sustainability of the Study Area was diagnosed in a comprehensive manner by applying the methodology proposed by JICA. The following six aspects were analyzed:

- Management of various risks brought about by rapid changes (environment, natural disasters, economy, society)
- Inclusiveness (poverty reduction, slum areas, socially vulnerable people)
- Attractiveness (greenery, amenity, scenery, historical and tourism resources)
- Urban management capability and urban infrastructures (planning and implementing capabilities, land management, urban planning system, human resource development, finance, service level of urban infrastructures)
- Participation (traditional practices and official systems at the planning and implementation stages)
- Broad perspective beyond administrative and national boundaries (competitiveness)

According to the diagnosis, sustainability in the Study Area is low, as the number of indicators for low sustainability (22) surpasses those showing high sustainability (6), as presented in Table 2.1 below:

Table 2.1 Sustainability of the Study Area

Indicator	Number of indicator with high sustainability	Number of indicator with low sustainability	Overall
1. Management of risks caused by rapid changes	2 ⁽¹⁾	4 ⁽²⁾	Low
2. Inclusiveness	1 ⁽³⁾	3 ⁽⁴⁾	Low
3. Attractiveness	0	4 ⁽⁵⁾	Low
4. Urban management capacity and urban infrastructures	0	8 ⁽⁶⁾	Low
5. Participation	1 ⁽⁷⁾	1 ⁽⁸⁾	Medium
6. National, international, regional perspective	2 ⁽⁹⁾	2 ⁽¹⁰⁾	Medium
Total	6	22	Low

Source: JICA Study Team

Note: ⁽¹⁾ CO₂ emission, ethnic conflict

⁽²⁾ Environment, natural disasters, global economy, social risk

⁽³⁾ Elderly protection (social safety net)

⁽⁴⁾ Poverty, access to school in irregular settlements, access to health facilities in irregular settlements

⁽⁵⁾ Investment environment, urban park, amenities, tourism

⁽⁶⁾ Urban planning system, personal capability for urban planning and management, financial capability, transport, water supply, sewerage/sanitation, solid waste management, power

⁽⁷⁾ Traditional participation

⁽⁸⁾ Official participation

⁽⁹⁾ International communication infrastructure, international cooperation (ECOWAS, UEMOA)

⁽¹⁰⁾ National and regional planning system, regional hub function in West Africa

In an effort to enhance the sustainability of the Study Area, these factors were assessed positively as high sustainability factors that could serve as the basis. The positive characteristics of the Senegalese people and their society are significant advantages. A peaceful society like Senegal, without almost any ethnic conflicts, is a fundamentally important strength in attracting investors and tourists, especially in an age when instability and risks are increasing. A tradition of democracy and participation also illustrates its openness toward different values and ways of thinking, an important asset for various forms of international cooperation. A favorable ICT infrastructure and internet coverage, as well as existing regional cooperation mechanisms in West Africa, add to these positive factors in enhancing Dakar's potential to strengthen its regional hub function, which could result in accelerated economic growth that creates more job opportunities. In all these efforts, consideration of the global environment would be important.

CHAPTER 3 THE 2035 MASTER PLAN

3.1 Vision, Objectives and Targets

(1) Vision

A vision for a city can only be shared when it integrates the views of the people living and working there. A development vision for the Study Area was prepared as below based on this concept. A vision workshop was held as part of the regular weekly meeting by the DUA and the JICA Study Team on January 28, 2015. Participants from the DUA expressed their ideas about a desirable situation for the Study Area, facilitated by the JICA Study Team. The key words expressed during the meeting were analyzed and organized. The ideas expressed in stakeholder meetings with civil society representatives and local administrative officers, as well as in policy directions within important government documents, were reviewed and reflected on in this process. The draft vision was prepared through this participatory process.

A “City of Hospitality”

A “City of Hospitality” is characterized by:

- ◇ a **comfortable** living environment,
- ◇ easy **communication**, and
- ◇ innovative **creation**.

It will be **inclusive, sustainable, competitive** and **supportive**.

Senegal is well known for its hospitality, or *teranga* in Wolof, which is probably the strongest in West Africa. The vision “City of Hospitality”, which is an expression proposed in the workshop with the DUA, is selected, since it encompasses all the ideas presented like an umbrella. . “Hospitality” indicates generosity, openness and receptiveness towards different values, both internally and externally.

It will be a city where people live comfortably without worries about basic needs, disasters, finance and security, in a relaxing environment with abundant green space and parks. It will also provide opportunities for cultural and sports activities.

It will be a city with easy communication. People will travel easily in the city and to other regions. Foreigners will enter into Senegal smoothly through Dakar and then continue to travel throughout the country. Commodities will be transported efficiently within the city and beyond the city boundary. Communication with other regions and countries will be easier, utilizing advanced telecommunication technologies.

It will be a city of innovative creation. People will enjoy locally produced commodities of good quality, both manufactured products and agri-products. Both Senegalese people and foreigners will enjoy the tourism opportunities that are unique to the region as well as original artisanal and artistic works.

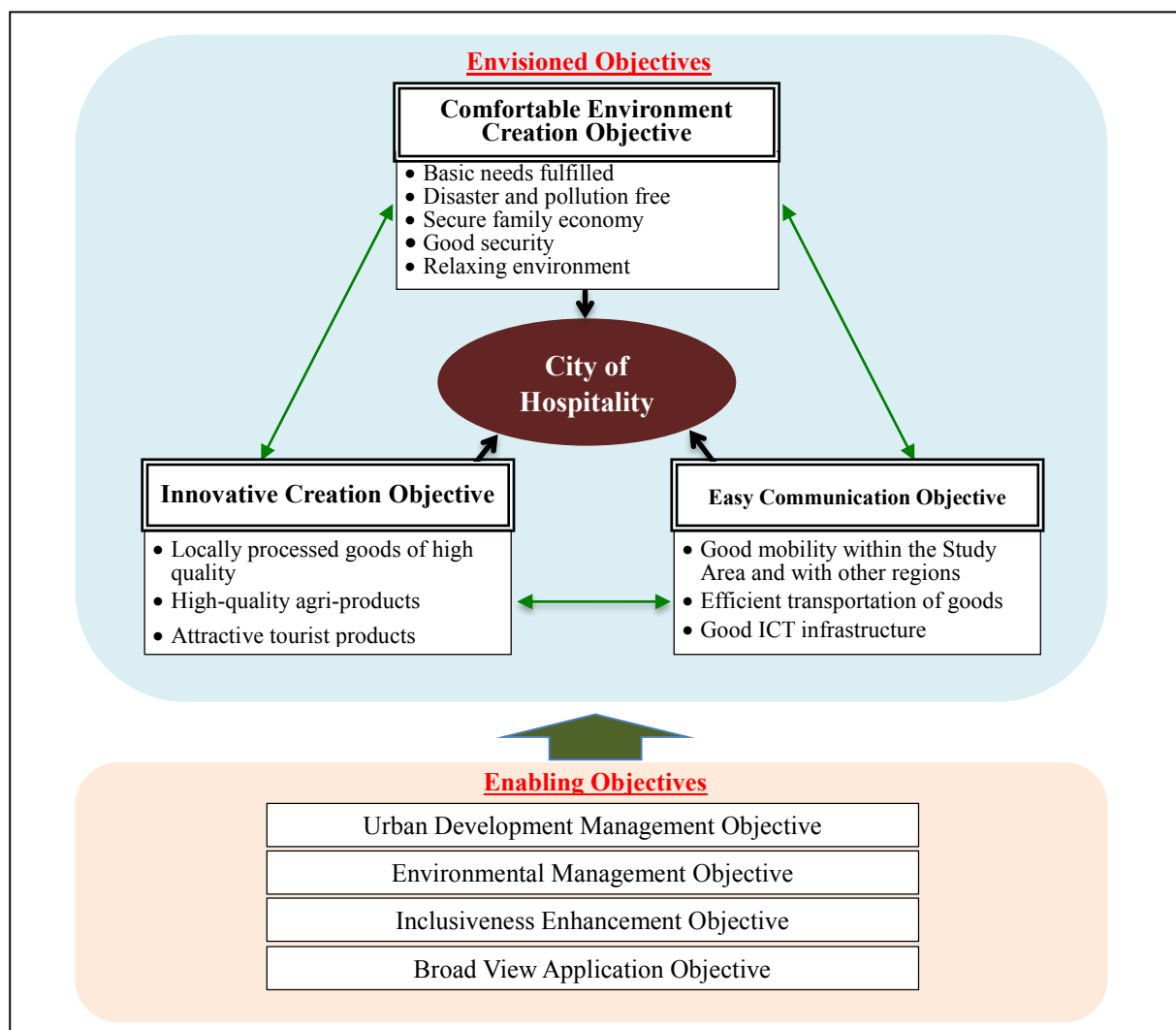
People of all classes, ethnic groups and statuses will enjoy these benefits (inclusive). Generations to come after 2035 will continue to enjoy these benefits (sustainable). With these strengths, Dakar and the adjacent area will be in the top position in West Africa (competitive). It will support and lead the development of the entire people of Senegal and other West African countries (supportive).

(2) Objectives and Targets

The vision of a “City of Hospitality” will be achieved by fulfilling a number of conditions. Those conditions could be called “envisioned objectives” and “enabling objectives”. Envisioned objectives are those perceived by participants at the stakeholder meetings, DUA counterparts and the social survey respondents in the process of vision formulation. They are the objectives for creating a comfortable environment, promoting easy communication and accelerating innovative creation. While not necessarily captured in the vision preparation process, enabling objectives are those that should be important in achieving the “City of Hospitality” vision. They are the objectives that concern institutional issues, macroscopic issues and the issue of protecting socially vulnerable people.

- (a) Envisioned objectives
 - ✓ Comfortable environment
 - ✓ Easy communication
 - ✓ Innovative creation
- (b) Enabling objectives
 - ✓ Urban development management
 - ✓ Environmental management
 - ✓ Inclusiveness enhancement
 - ✓ Broad view application objective

They are conceptualized in the figure below.



Source: JICA Study Team

Figure 3.1 Envisioned and Enabling Objectives to Achieve a “City of Hospitality”

Targets for Sustainability Enhancement

Specific targets for each of these seven objectives are established by referring to and realigning the indices clarified in the sustainability diagnosis, in such a way as to correspond to these seven objectives. These targets are established from the perspective of enhancing the quality of life for the people and improving the business environment, as well as from the perspective of minimizing the load on environment.

Table 3.1 Targets for Envisioned and Enabling Objectives to Realize a “City of Hospitality”

Component	Targets in 2035
I. Comfortable Environment Creation Objective (Envisioned Objective)	
1. Urban infrastructure services	
1.1 Water resources*	<ul style="list-style-type: none"> Diversification of water sources: 84 % and seawater desalination system (internal) at 16 %
1.2 Water supply*	<ul style="list-style-type: none"> Water supply service coverage to reach 100 % in the whole Study Area. Restraining average water consumption per capita to 63-75 liters per capita per day (lcd)
1.3 Sewerage and sanitation*	<ul style="list-style-type: none"> Expanding the sewerage network coverage from 25 % to 63 % Increasing access to sanitary toilets from 54 % to 100 %

1.4 Solid waste management*	<ul style="list-style-type: none"> • Raising solid waste collection rate from 67 % to 88 % • Raising garbage recycling from 0 % to 4 %
1.5 Electricity and renewable energy*	<ul style="list-style-type: none"> • Decreasing the electricity generation cost from FCFA 170-190 per kWh at present to an average of about FCFA 55 per kWh • Increasing power generation by renewable energies to 15 %
2. Natural disaster*	<ul style="list-style-type: none"> • Preventing flood damages by non-structural measures and structural measures • Preventing coastal hazard damage by restricting habitation along the coastal area
3. Security problems	<ul style="list-style-type: none"> • Raising Senegal's position from 5th to 1st among the 33 Sub-Saharan countries in terms of the number of homicides per 100,000 of the population • Improving the security situation so it is no longer perceived as a problem by the people
4. Urban park and green space*	<ul style="list-style-type: none"> • Increasing the urban park area from 0.15 m² per person at present to 1.0 m² per person
II. Easy Communication Promotion Objective (Envisioned Objective)	
5. Transport*	<ul style="list-style-type: none"> • Raising road density from 1.0 km per km² to 2.0 km per km² and the proportion of paved roads from 36 % to 70 % • Decreasing the number of fatalities caused by traffic accidents from 1.4 people per 100,000 of the population to 1.0 • Decreasing on-street parking from 90 % to 40 % and irregular parking from 50 % to 10 %
6. Logistics*	<ul style="list-style-type: none"> • Raising Senegal's position from 5th among the 12 ECOWAS countries to 1st in terms of the World Bank's Logistics Performance Index (LPI) • Dakar to function as the Western gateway for West Africa
7. ICT	<ul style="list-style-type: none"> • Raising Senegal's position from 2nd among the 12 ECOWAS countries to 1st in terms of the number of fixed (wired) broadband subscriptions • Raising Senegal's position from 3rd among the 12 ECOWAS countries to 1st in terms of individual internet use
III. Innovative Creation Promotion Objective (Envisioned Objective)	
8. Production*	<ul style="list-style-type: none"> • GRDP to grow at 7.8 % per year on average, 5.7 % per year for the primary sector, 8.9 % per year for the secondary sector and 7.4 % per year for the tertiary sector • GRDP per capita of the Study Area to reach US\$ 5,632 by 2035
9. Foreign direct investment	<ul style="list-style-type: none"> • Raising Senegal's position from 6th among the 12 ECOWAS countries to 1st in terms of the World Bank's Doing Business ranking
10. Tourism*	<ul style="list-style-type: none"> • Increasing the number of visitors to the regions of Dakar from 445,000 to 1,580,000
11. Export	<ul style="list-style-type: none"> • Diversifying the composition of export markets: from 12 % to 25 % for Europe, from 0.1 % to 5 % to America, from 14 % to 20 % to Asia, and decreasing the export to Africa from 69 % to 50 %
IV. Urban Development Management Objective (Enabling Objectives)	
12. Urban planning system*	<ul style="list-style-type: none"> • Objectives and specifications of urban development plans, such as the SDAU, the PDU and the PUD, to be clearly defined • All stakeholders following these urban development plans
13. Technical capability*	<ul style="list-style-type: none"> • Upgrading the DUA's technical capability to be able to support local government in preparing PDUs and PUDs • Upgrading the technical capability of local government to be able to prepare PDUs and PUDs with the guidance of the DUA
14. Financial capability*	<ul style="list-style-type: none"> • Enhancing the DUA's financial capability for undertaking activities to support local government • Securing a minimum budget to enable local government to prepare a PDU and a PUD
V. Environmental Management Objective (Enabling Objectives)	
15. GHG emission	Restraining the increase of CO ₂ emission per person from 5.03 CO ₂ per person per year at present in the Dakar Region to 6.8 CO ₂ e in 2035, an 135 % increase, by achieving an income elasticity of CO ₂ e emission at 0.5
16. Land use*	Allocating at least 45 % of the entire Study Area to farm lands and natural areas including wetlands

17. Pollution and illegal activities damaging the environment	Ensuring no industrial pollution or illegal activities damage the environment
VI. Inclusiveness Enhancement Objective (Enabling Objectives)	
18. Poverty	<ul style="list-style-type: none"> • Reducing the poverty population in terms of \$1.25 PPP (purchasing power parity rate at FCFA 283 FCFA/US\$ applied) per person per day, from 22.3 % at present to 0.0 % • Improving income disparity in the Study Area by reducing the Gini coefficient from 0.399 at present to 0.30
19. Basic human needs	Reducing the problems of irregular settlements to the level at which no complaints will be made about the distance to a primary school, problems with a primary school, the distance to health centers, the service level of health centers and the levels of infrastructure services, such as water, sanitation, solid waste and electricity
20. Public transportation*	<ul style="list-style-type: none"> • Reducing the mode share of informal public transport from 64 % to 0 %. • Reducing the proportion of irregular settlement residents who are not satisfied with public transportation from 93 % to 20 %
22. Social safety net	Increasing the coverage of social insurance for adults older than 60 years of age from 35 % at present, second in Sub-Saharan countries after South Africa, to 100 %
VII. Broad View Application Objective (Enabling Objectives)	
23. National and inter-regional plans	Timely preparation of upper level plans at national and inter-regional levels, such as the SDAU, the PGAT and national socioeconomic plans (e.g., the PSE)
24. International cooperation mechanism	Senegal to become competitive, taking advantage of the further economic integration of West African countries through the ECOWAS and the UEMOA

Source: JICA Study Team

Note: The components with * are those for which detailed analyses are presented in the main text of the final report.

3.2 Sustainability Enhancement Strategy

A set of sustainability enhancement strategies is proposed as follows:

Comfortable Environment Creation Strategy

- Apply both structural and non-structural measures to tackle the increasing need for urban infrastructures, thus enhancing the capacities of the structures and restraining demand
- Minimize the damage caused by natural disasters by integrating structural and non-structural measures effectively
- Prevent and minimize law and order problems through the integration of a crime prevention perspective in urban planning and design processes as well as enhancing community initiatives
- Increase the urban park area in the Study Area by securing sufficient spaces for urban parks at the planning stage for newly urbanizing areas and converting non-park areas to urban parks through restructuring programs

Easy Communication Strategy

- Integrate transportation planning into land use planning to create an urban structure that is economically and environmentally desirable
- Efficiently utilize transport infrastructure capacities by effectively integrating non-structural and structural measures in order to ensure the smooth mobility of goods and people for economic development as well as improve the quality of life of the people

- Promote public transportation by integrating public transport planning into land use planning and emphasizing more cost-efficient options
- Increase the competitiveness of the logistics sector by overcoming weaknesses, such as timeliness and infrastructure, and further enhance relative strengths, such as customs and international shipment
- Support private initiatives for developing fixed and mobile broadband network infrastructures as well as promoting the application of ICT to various public services

Innovative Creation Promotion Strategy

- Integrate the production sectors into the urban planning process in the Study Area as an important component of job creation and income generation
- Actively introduce foreign direct investment to the Study Area for all the economic sectors so that their advanced technology and funding capacity support the Study Area in boosting its economy
- Promote primary sector production, such as urban agriculture and fisheries, taking advantage of natural local resources
- Promote tourism capitalizing on the strengths of Senegal, such as people's hospitality, nature, history, culture and art, as well as cooperating with other ECOWAS countries to create a West African brand
- Promote the export of Senegalese products, strategically based on the preferences and conditions of potential markets alongside the strengths of Senegal and the Study Area

Urban Development Management Strategy

(Urban Planning System)

- Enhance the recognition of people and the private sector toward the Master Plan
- Enhance the supporting tools for the Master Plan
- Enhance recognition of the Master Plan in central government organizations and local government
- Strengthen the monitoring and surveillance function as well as expand the financial base to implement the proposed projects for realizing the Master Plan
- Formulate a national planning and urban management strategy, which integrates risks and defines the concept, principles and approaches of a *sustainable city* for Senegal

(Capacity Development)

- Clarify the ultimate roles and functions of relevant organizations related to urban planning, such as the DUA and local government, and the transition process
- Strengthen the institutional and organizational capacities of relevant organizations
- Strengthen the individual capacities of the officers within relevant organizations to support the expected roles and functions of each organization

(Financial Capability)

- Maximize the budget by effectively demonstrating the importance of urban plans to the government while minimizing expenditure

Environmental Management Strategy

- Plan and create a city that would minimize CO₂ emission as a collaborative effort of communities, businesses and local government, as well as improve people's lifestyles and production

- Create a land use model that ensures a good balance of urban, agricultural and natural spaces, as well as guarantees the conservation of natural resources
- Minimize pollution by industries and illegal activities damaging the environment through strengthening collaboration between central government, local government, industries and local communities

Inclusiveness Enhancement Strategy

- Promote the creation of job opportunities and income generation for poorer segments of the population in all spheres of economic activity, effectively linking them with larger scale economic activities
- Promote the redistribution of income and wealth by improving the tax and social insurance systems
- Improve access to and the quality of services for basic education and health services in irregular settlements as part of a restructuring program
- Improve access to and quality of the public transportation service for irregular settlement residents
- Expand the social safety net systems for socially vulnerable people and provide support measures to upgrade their status and conditions

Broad View Application Strategy

- Prepare a new national development plan capitalizing on the achievements of the PSE and subsequent national plans as well as integrating the latest international and national conditions

A set of measures to realize the strategies presented above is proposed in the main text.

3.3 Socioeconomic Framework

A socioeconomic framework for the Study Area was established based on a number of assumptions in the rate of natural population growth, the rate of migration, economic growth rates targeted in the PSE and other policy documents, and desirable levels for social indicators as shown in Table 3.2.

Table 3.2 Socioeconomic Framework for the Study Area

Item		Unit	2013	2025	2035
Population		1,000	3,206	4,705	6,084
Working age population		1,000	1,971	3,058	4,259
Labor force	Total	1,000	1,078	1,835	2,768
	Primary	1,000	21	14	11
	Secondary	1,000	302	514	775
	Tertiary	1,000	755	1,307	1,982
GRDP (Factor price at 1999)	Total	FCFA billion	3,295	7,937	17,136
	Primary	FCFA billion	10	14	17
	Secondary	FCFA billion	838	2,357	5,449
	Tertiary	FCFA billion	2,447	5,566	11,670
Average GRDP growth rate	Total	%	-	7.6	8.0
	Primary	%	-	5.8	5.6
	Secondary	%	-	9.0	8.7
	Tertiary	%	-	7.1	7.7
GRDP per capita (real)		US\$	2,056	3,373	5,632
GRDP per capita average growth rate		%		4.2	5.3
School enrollment (primary)		%	117.1	108.0	100.0
School enrollment (secondary)		%	80.1	90.0	96.0
Under-five mortality rate		Per 1,000 persons	59	30	10
Birth assisted by a skilled provider		%	95.0	100.0	100.0

Source: JICA Study Team estimates based on the DPEE's projection, National Educational Statistics, UNICEF

Note: Education and health indicators are used in the Dakar region.

GRDP growth rates in 2013, 2025 and 2035 show average growth rates in the 2002-2013, 2013-2025 and 2025-2035, respectively.

3.4 Spatial Development Framework

The future urban area must accommodate the capacity to meet the socioeconomic framework. On the other hand, the natural environment must also be preserved to create a living habitat. The spatial development framework is examined in order to identify a probable urbanization pattern with a good balance for the socioeconomy, natural environment and urban activities.

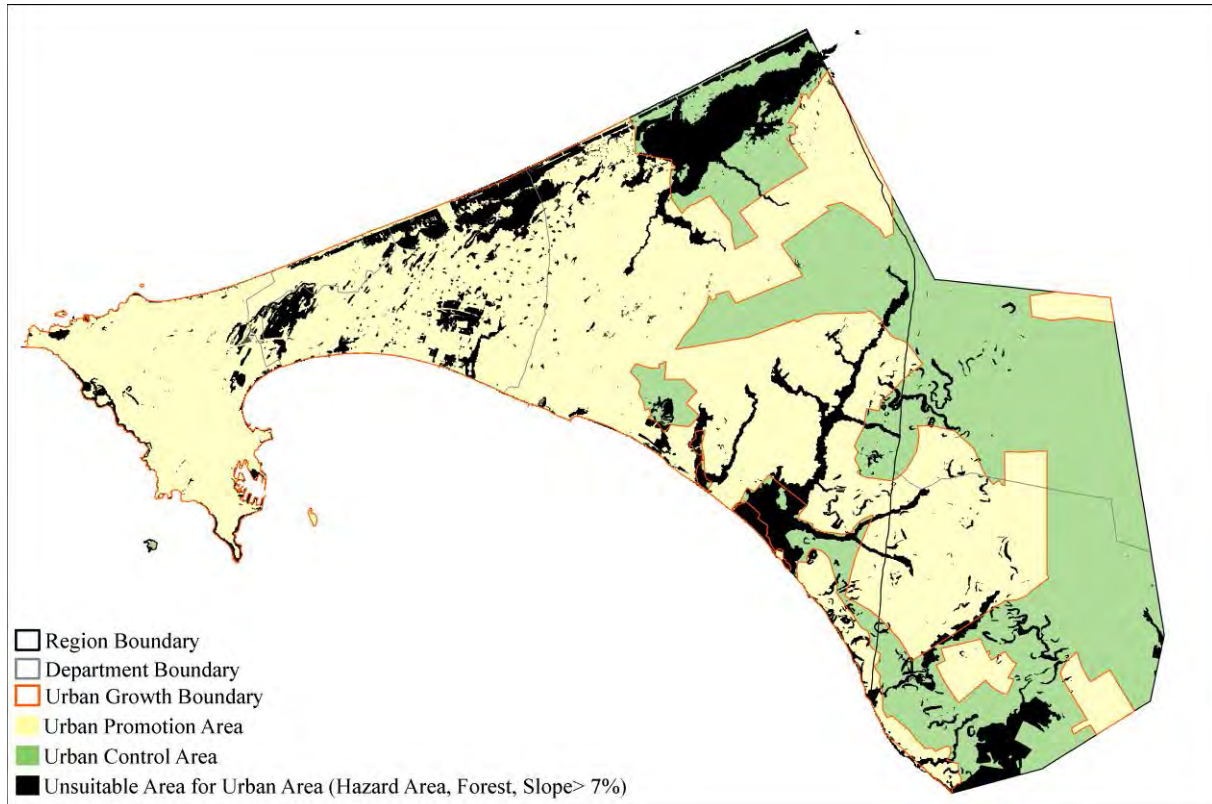
(1) Delineation of the Urban Growth Boundary

The continued influx of population is forcing the expansion of the built-up area. Currently, expansion of housing areas is underway in unsuitable locations, such as classified forests and hazardous areas. It is necessary to distinguish suitable areas for urbanization from those areas that need to be controlled or restricted. Specifically, the following four factors are critically important for the sustainable development of the Study Area:

- Delineation of the boundaries to show the area for urbanization in order to keep the city compact.
- Restriction of housing in hazardous areas to ensure a safe living environment for citizens and to enable the efficient provision of public services. The hazardous areas are vulnerable to high tide, flooding and coastal erosion.
- Conservation of agricultural lands not only to promote urban agriculture, but also to ensure rainwater infiltration and groundwater recharge, as well as to mitigate the rainfall run-off discharge.
- Conservation of classified forests, existing forests and agriculture lands suitable for cash crops.

In light of these factors, it is proposed to introduce an urban growth boundary (UGB), which would

demarcate the administration area into two areas: i) the urban promotion area and ii) the urban control area. The future urban area is to be encouraged and planned inside the UGB, while urbanization is to be controlled or discouraged outside it. Figure 3.2 shows a conceptual drawing of the UGB that demarcates the urban promotion area, the urban control area and the areas unsuitable for the urban area.



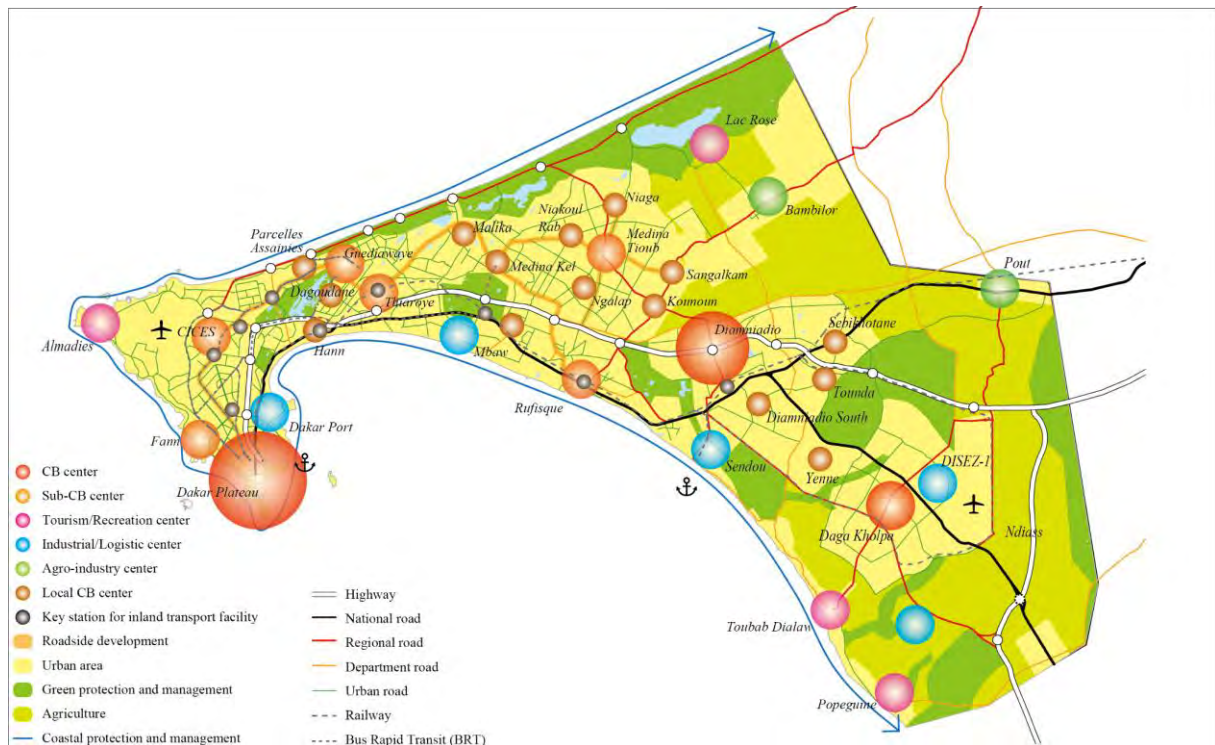
Source: JICA Study Team

Figure 3.2 Urban Growth Boundary in the Study Area

(2) Envisaged Future Urban Structure

Following the direction specified in the Master Plan for the Territorial Development of the Dakar-Thiès-Mbour Area by the National Agency for Regional Development and based on the analyses of the alternatives for spatial development scenarios, a future urban structure is elaborated to show the envisaged urbanization pattern as shown in Figure 3.3. The following issues are taken into account:

- Promotion of east and southeast urban expansion with the Diamniadio and Daga Kholpa urban poles.
- Promotion of development along mass public transport networks.
- Suppression of urbanization in hazardous areas.
- Conservation of the Niayes areas and classified forest areas.
- Creation of green belt encompassing agglomeration.
- Creation of inter-regional trunk roads and urban trunk roads to interlink urban sub-centers.
- Transformation of the industrial areas along the coast to public use.
- Differentiation of urban poles, urban centers and sub-centers with unique functions.



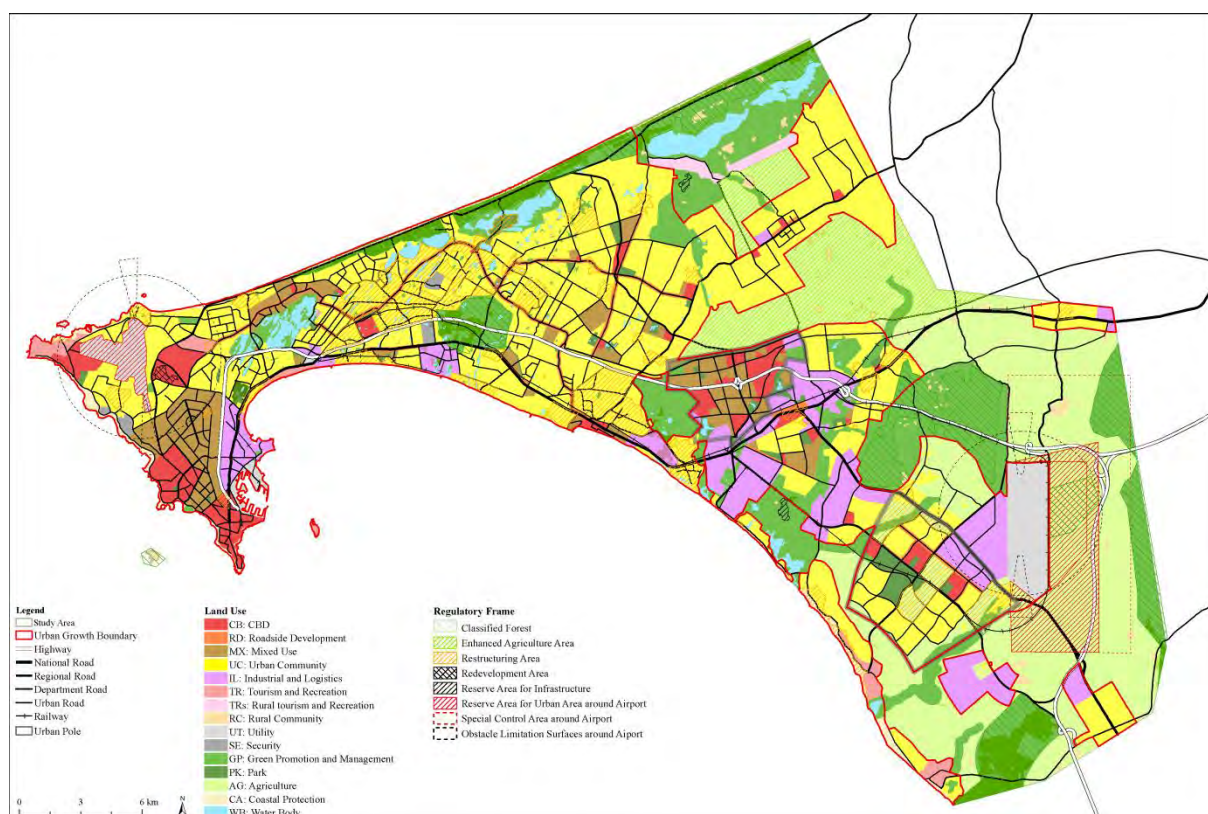
Source: JICA Study Team

Figure 3.3 Envisaged Overall Urban Structure

(3) Proposed Land Use Plan

The land use plan in the 2035 Master Plan is to provide a broad vision for future development of the Study Area. First, the Study Area is divided into two broad categories: one is for urban usage (Urban Promotion Area: UPA), and the other is essentially not for urban usage (Urban Control Area: UCA). Second, the UPA is further classified into three broad categories according to the nature of the urban function: residential, business and commercial, and industrial. Third, some of the major urban facilities need to be depicted in the land use plan. The facilities include i) main roads, seaport and airport, ii) parks and greenery, and iii) rivers, lakes and ponds. Although these are generally shown in the land use map, the specific boundaries of these facilities need to be clarified through detailed survey works. Figure 3.4 shows the proposed land use map. Table 3.3 shows the composition of land use corresponding to the proposed land use plan.

Furthermore, the population distributed to the urban agglomerations and the administrative units and indicative locations of regional educational and health facilities are analyzed, as shown in the main text.



Source: JICA Study Team

Figure 3.4 Land Use Plan for Study Area in 2035

Table 3.3 Composition of Proposed Land Use

Code	Land Use	Land Area (ha)			%		
		Urban Promotion Area	Urban Control Area	Total	Urban Promotion Area	Urban Control Area	Total
CB	CBD	2,726	0	2,726	3.3	0.0	3.3
RD	Roadside Development	1,191	0	1,191	1.5	0.0	1.5
MX	Mixed Use	3,432	0	3,432	4.2	0.0	4.2
UC	Urban Community	24,887	0	24,887	30.4	0.0	30.4
IL	Industrial and Logistics	5,598	0	5,598	6.8	0.0	6.8
TR	Tourism and Recreation	688	0	688	0.8	0.0	0.8
TRs	Rural Tourism and Recreation	0	385	385	0.0	0.5	0.5
UT	Utility	2,115	0	2,115	2.6	0.0	2.6
SE	Security	190	0	190	0.2	0.0	0.2
PK	Public Park	1,143	0	1,143	1.4	0.0	1.4
GP	Green Promotion and Management	4,500	10,615	15,115	5.5	13.0	18.5
AG	Agriculture	2,137	18,509	20,646	2.6	22.6	25.2
CA	Coastal Protection	1,066	0	1,066	1.3	0.0	1.3
RC	Rural Community	0	705	705	0.0	0.9	0.9
WB	Water Body	1,143	864	2,006	1.4	1.1	2.4
IS	Island	13	0	13	0.0	0.0	0.0
	Total	50,828	31,078	81,906	62.1	37.9	100.0

Source: JICA Study Team

CHAPTER 4 SECTOR DEVELOPMENT PLANS FOR 2035

4.1 Economic Development

Objectives and Development Strategies

The objectives and strategies for economic development are examined for specific sub-sectors of agriculture, fisheries, industry and tourism, as shown in Table 4.1.

Table 4.1 Objectives and Strategies for Economic Development by Sub-Sector

Item	Agriculture and Fisheries	Industry	Tourism
Objectives	<ul style="list-style-type: none"> To promote urban-based farming system focusing on fruits, flowers and vegetable production To increase high value added products in fisheries 	<ul style="list-style-type: none"> To help boost Senegal's economic development through improving the investment environment 	<ul style="list-style-type: none"> To contribute to economic growth through foreign currency earnings and job creation To enhance historical and cultural attractiveness To contribute to the protection of the natural environment
Development strategies	<ul style="list-style-type: none"> Conservation and protection of agricultural land Introduction of effective management systems for reduction of risks, support for marketing and environmental sustainability Enhancement of fisheries-related facilities for the increase of high value added products Promotion of horticulture in Niaye through strengthening producers' organizations, research and development of water-saving cultivation technology, promotion of organic agriculture with high value added, and promotion of integrated agriculture system for environmental conservation 	<ul style="list-style-type: none"> Development of industrial sites or zones for relocation of the existing industries which may cause environmental damage Rehabilitation of the infrastructure in the existing industrial sites and zones Development of new industrial zones with integration of SEZs Formulation of rules and regulations to promote quality management and provide incentives for foreign direct investment and development of industrial zones and SEZs SME development by enhancement of linkages among SMEs and craft industries as well as formalization of SME and informal sector Human resource development by enhancement of technical and vocational education and training (TVET) 	<ul style="list-style-type: none"> Establishing image as a key tourism destination Strengthening international gateway function for Senegal tourism Developing and promoting various tourism products Formulation of attractive destination environment in association with urban development
Development target	<ul style="list-style-type: none"> GRDP: FCFA 17 billion (1999 price) Employment: 11,000 	<ul style="list-style-type: none"> GRDP: FCFA 5,449 billion (1999 price) through 8.9 % per year growth Employment: 775,000 	<ul style="list-style-type: none"> Accommodation guests arrival: 820,000 in Dakar and 760,000 in Thiès

Source: JICA Study Team

4.2 Urban Transport

Objectives and Development Strategies

The objectives and strategies for the urban transport sector are established following the urban transport master plan for Dakar (PDUD 2025) as follows:

- (a) To enhance national and regional economic competitiveness
 - ✓ To increase road capacity through the development and improvement of road networks
 - ✓ To make the most of the existing capacity through traffic control and information systems
- (b) To prepare an urban transport plan supported by efficient and sound financing
 - ✓ To avoid excessive traffic concentration (i.e., economic loss of travel time) and to balance the travel demand and the transportation infrastructure supply or capacity through traffic demand management and development controls
 - ✓ To decrease excessive vehicular traffic demand through transportation demand management and diverting private vehicle users to public transport
- (c) To facilitate easier and improved mobility for people
 - ✓ To improve the level of service of the existing public transport system
 - ✓ To develop new mass transit systems
 - ✓ To keep public transport fares affordable
- (d) To contribute to the sustainable development of the region
 - ✓ To enhance inter-modality through development and improvement of transfer facilities
 - ✓ To apply transit-oriented development (TOD) for major public transport corridors including sub-centers
- (e) To provide a better quality of life
 - ✓ To decrease air pollution and noise by enforcing the regulations
 - ✓ To enhance traffic safety through law enforcement, public campaigns, training and education
 - ✓ To provide user-friendly transportation facilities

Development Target

Development targets are proposed to realize the development strategies as shown in Table 4.2.

Table 4.2 Performance Targets in Road Network and Urban Transportation

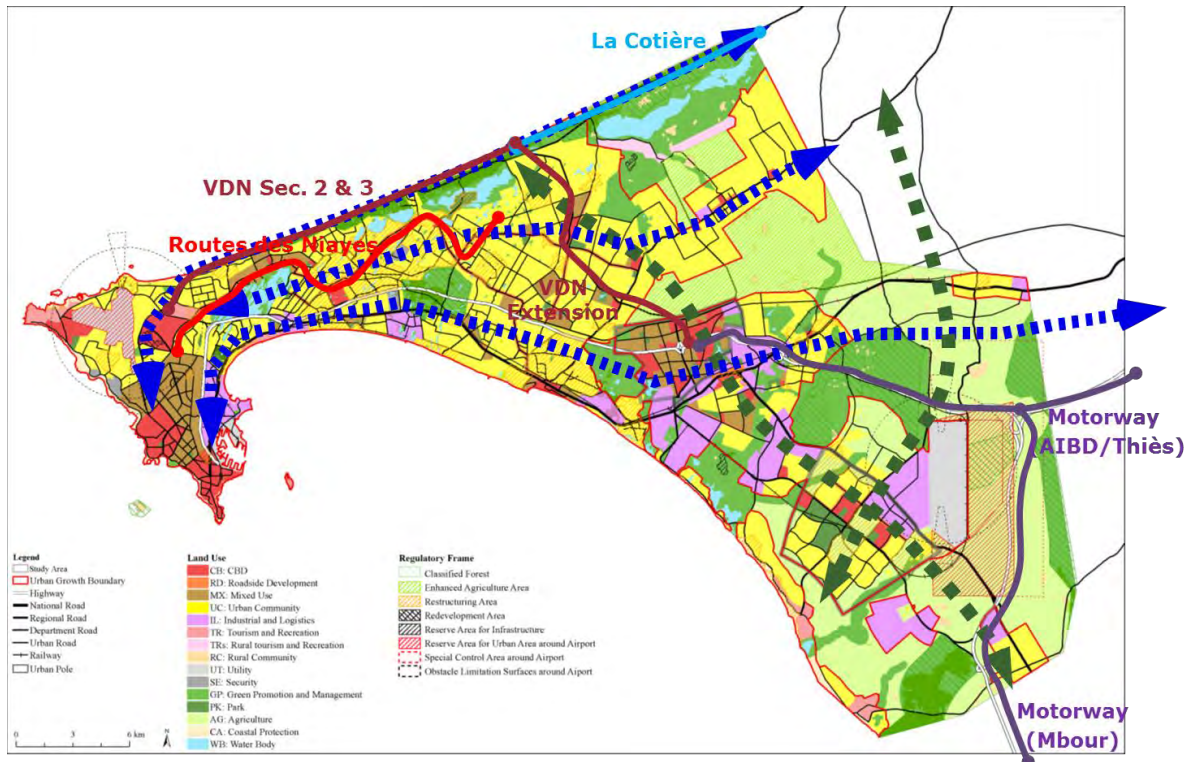
Performance Measures	Present Condition	Target in 2035	Performance Measures	Present Condition	Target in 2035
Dakar Region			Mode Shares (out of all modes)	(as of 2000)	
- Paved road density (km/km ²)	1.01	2.0	- Mode share of public transport (%)	65.9	75
- Ratio of paved roads (%)	35.5	70	- Mode share of informal public transport (%)	63.6	0
- Number of fatalities per 100,000 persons in traffic accidents	3.65	1.0	- Mode share of mass rapid transit including BRT and rail (%)	0.3	25
- Average length of motorized trips (km)	(as of 2000) 5.6	10	Convenience and Comfort		
CBD (Plateau zone)	(as of 2004)		- Average operational speed of conventional bus (km/h)	15	20
- Ratio of on-street parking to all paid parking (%)	90	40	- Residents having a problem with public transport (%)	87	20
- Ratio of irregular parking to all parking (%)	50	10	Cost	(as of 2000)	
Private Car Traffic	(as of 2000)		- Average household expenditure for public transport/average total household expenditure (%)	5.4	3.0
- Mode share of private car	10.2	20			
- Average occupancy (persons/vehicle)	2.5	2.5			

Sources: JICA Study Team, based on data from AGEROUTE, Direction of Land Transport and CETUD

Development Plan

Based on the proposed land use plan, major road projects are proposed in the east-west and the north-south directions. The east-west corridors consists of three routes: i) the national road (RN1 and RN2) and toll motorway in the south, ii) VDN and La Cotière in the north, and iii) the extension of

Niayes Road in the middle. As for the two major corridors in the north-south, the inner corridor is connected with all the three east-west corridors. The other outer periphery corridor connects Bayakh, Pout, AIBD and Daga Kholpa, as shown in Figure 4.1.

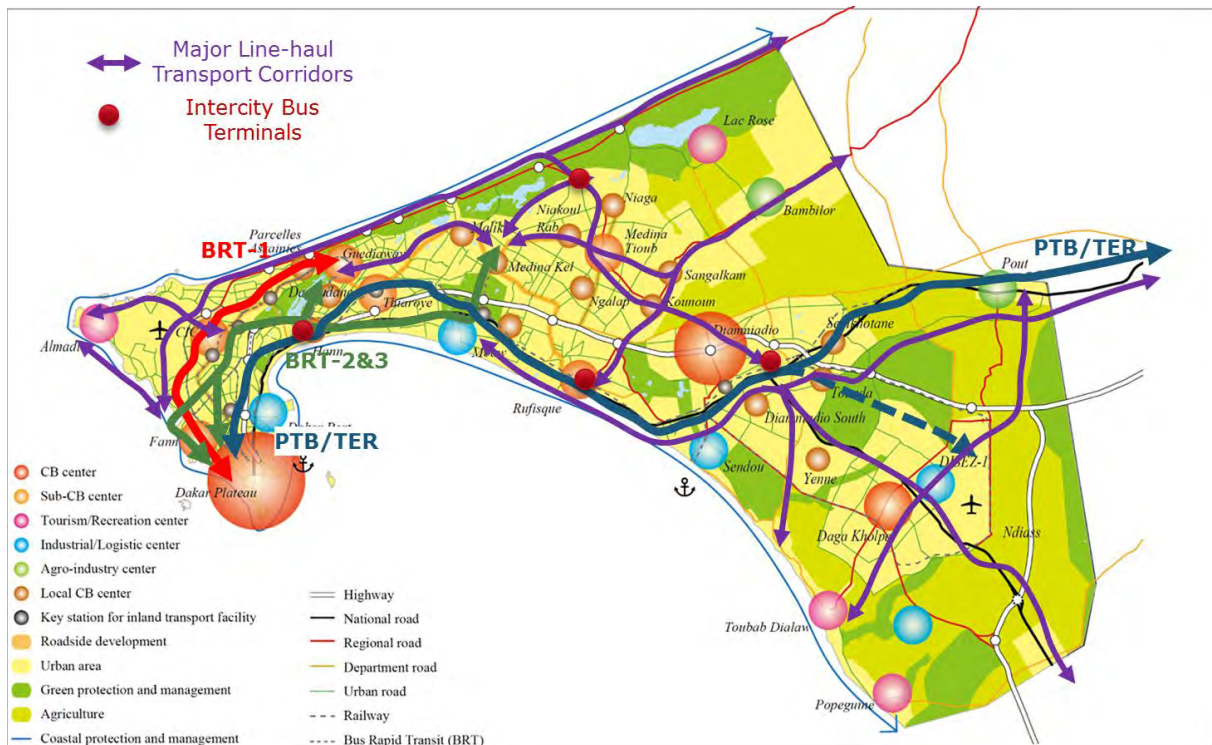


Source: JICA Study Team

Figure 4.1 Major Road Projects

As for the public transport plans, they will also serve the major roads and the urban poles. There are three major public transport projects serving the high-capacity corridors, as shown in Figure 4.2. The first high-capacity corridor is BRT-1, which is a pilot project with a route from Guédiawaye to Dakar Main Station via Niayes Road and Rue 10. The other two lines of the BRT will connect North Pikine and Keur Massar.

The Senegalese government is currently promoting the Regional Express Train (TER) connecting the main stations of Dakar, Fass Mbao, Rufisque, Bargny, Diamniadio, Thiès and possibly AIBD. The PTB's operation from Dakar to Thiès will be replaced by the TER. Furthermore, in order to supplement these high-capacity corridors, other major line-haul transport corridors are proposed on the assumption that they are to be served by regular buses, such as the DDD. The type of public transport mode should be selected for each line-haul transport corridor to meet the demand forecast and the service distances.



Source: JICA Study Team

Figure 4.2 Development of Major Public Transport Lines

4.3 Logistic Infrastructure

Objectives

- To contribute to the sustainable development of economic activities in Senegal through the development of logistics infrastructure
- To make Senegal a logistical hub in the region (West Africa) by strengthening the competitiveness of the logistics infrastructure

Development Strategies

- To strengthen the function of Dakar Port through its expansion, rehabilitation and restructuring together with improving access to Dakar Port
- To develop alternative or secondary port(s) to reduce the degree of overconcentration in Dakar Port for risk aversion
- To facilitate the supporting infrastructures for easy access to AIBD
- To overcome various crucial problems of the road system in terms of physical infrastructure raised by concerned organizations and users
- To strengthen the function and increase the capacity and efficiency of the Dakar-Bamako corridor, especially the railway
- To develop a logistical platform/distribution center and trucking terminal to remove existing problems and improve efficiency

Development Target

- Development target in 2025
 - ✓ Senegal to rank first in ECOWAS according to the WB indicator

- ✓ Senegal's performance to be above average for the Sub-Saharan African region and for lower-middle income countries according to the all OECD performance indicators
- Development target in 2035
 - ✓ Senegal maintains its first place in ECOWAS in the World Bank indicator.
 - ✓ Senegal's performance to be close to the best for the Sub-Saharan African region and for lower-middle income countries according to the all OECD performance indicators

Demand Forecast

The future cargo throughputs at Dakar Port are estimated at 23.9 million tons in 2025 and 44.9 million tons in 2035, respectively. The estimated volume in 2035 is 280% greater than the one recorded in 2013.

Development Plan

The following logistic infrastructure development plans are proposed to meet the development strategies:

- Formulation of a new Dakar Port master plan
- Improvement of Dakar Port and access to/from Dakar Port
- Improvement of logistics facilities in Mbaob and around the new international airport
- Development of alternative or secondary port(s) in Bargny and Kaolack
- Development of logistics facilities according to the future land use plan

4.4 Water Resources and Water Supply

Objectives

- To develop alternative water sources
- To improve the effectiveness and efficiency of the water distribution system
- To restrain water demand as much as possible
- To use precious water resources in a sustainable and well-coordinated manner

Development Strategies

- Basic improvement strategies
 - ✓ Development of water resources by desalination of seawater with careful consideration to feasibility and sustainability
 - ✓ Improvement of the water distribution system by reducing leakages in pipelines and malfunctioning of pumps
 - ✓ Improvement in the water quality of groundwater to be used for drinking and non-drinking purposes, such as industrial and agricultural uses
- Sustainability enhancement strategies
 - ✓ Promotion of water saving and recycling to enhance the efficient use of water
 - ✓ Implementation of an integrated water resources management plan to protect the environment with consideration to social and economic aspects
 - ✓ Understand the need for a multiple distribution system to reduce the risk of the whole system likely failing in an emergency

Development Target

- House connection rates (level 3 service) will be increased to 99 % in Rufisque, 96 % in Thiès, and 100 % in the other departments in Dakar, as shown in Table 4.3.

Table 4.3 Proposed Access Rates of House Connections (%)

Department	2013	2025	2035	Department	2013	2025	2035
Dakar	96	100	100	Rufisque	88	92	99
Guédiawaye	96	100	100	Thiès Study Area	No data	67	96
Pikine	96	100	100				

Source: JICA Study Team, based on information from SONES

- The cost recovery rates will be improved from 98 % to 100 % by 2035.
- The unit water demand consumption rates will be restrained to a level that will not hamper living standards, but will still be adequate, as shown in Table 4.4.

Table 4.4 Proposed Domestic Water Unit Consumption Rates

Department	Unit	2013	2025	2035
Dakar	ℓ/cap/day	68	72	75
Guédiawaye and Pikine	ℓ/cap/day	51	61	70
Rufisque	ℓ/cap/day	43	53	63
Thiès Study Area	ℓ/cap/day	43	56	70

Source: JICA Study Team, based its information on SONES, KMS3 Study 2015 and *Mission de Collecte d'Information pour l'Approvisionnement en Eau de la Région de Dakar*, JICA, 2014

- The non-revenue water (NRW) rates will be reduced from 23 % in Dakar and 19 % in Thiès to 10 % for both in 2035.

Demand Forecast

The SONES' forecast for water demand is reviewed, and the alternative demand forecasts are estimated at 441,832 m³ per day in 2025 and 594,159 m³ per day in 2035 on the average daily consumption basis, respectively.

Development Plan

The planned SONES programs and projects are examined to confirm the relationship between distribution and demand, as shown in table below. The projects planned by the SONES are supported by the Study as the means to meet the increasing water demand until 2035.

Table 4.5 Water Demand Forecasts and Distribution Scheduling

Component (m ³ /day)		2013	2015	2020	2025	2030	2035
Demand Forecasts in Study Area	Average	287,817	309,097	363,003	441,832	503,561	594,159
	Peak	316,599	340,007	399,304	486,016	553,917	653,575
Existing distribution		349,000	349,000	306,605	306,605	306,605	306,605
Urgent program			61,160	26,180	26,180	26,180	26,180
Complementary urgent program				20,000	20,000	0	0
Mamelles desalination plant						100,000	100,000
Grand Côte desalination plant				50,000	50,000	50,000	50,000
Ngnith plant reinforcement				10,000	10,000	10,000	10,000
KMS3 purification plant				100,000	100,000	200,000	200,000
Total distribution	Total area incl. Louga and Thiès	349,000	410,160	512,785	512,785	692,785	692,785
	Study Area equivalent	335,000	394,000	492,000	492,000	665,000	665,000

Source: JICA Study Team, based on information from KMS3 Study 2015, SONES and JICA Mission (December 2015)

4.5 Sewage and Sanitation

Objectives

- To upgrade the living environment with appropriate sanitation for all people

- To decrease the pollution load in order to mitigate environmental impact

Development Strategies

- To upgrade the sanitary environment with hygienic toilets to reduce water contamination in groundwater
- To strategically expand the coverage area of the sewerage system in the urban area in an affordable manner
- To appropriately manage the septage generated from on-site sanitation facilities in the non-sewered areas at septage treatment facilities to reduce pollution load
- To utilize sewage as a resource for biomass energy and reclaimed water

Development Target

All people must have access to hygienic toilets by 2035 in non-sewered areas.

The urban area must be covered by the sewerage system, with the exception of Sindia, Pout and the Coast, where the sewerage system is an inefficient solution due to their small population sizes, low densities and remote locations. According to the investment program in the PDA, the coverage ratio will be increased in an affordable matter as shown in table below:

Table 4.6 Proposed Coverage Ratio in Sewered Area

Sewered Area	2013			2035		
	Population (1000)	Coverage Ratio (%)	Sewered Population (1000)	Population (1000)	Coverage Ratio (%)	Sewered Population (1000)
Cambérène	761	50	381	932	100	932
Baie de Hann	516	10	52	745	58	432
Corniche Ouest	574	55	316	758	100	758
Est	764	0	0	877	10	88
Niayes	13	50	7	15	47	7
SHS	18	45	8	21	38	8
Rufisque Center	255	8	19	478	100	478
Rufisque North	108	0	0	1,109	10	111
Diarniadio	50	0	0	648	100	648
Daga Kholpa	26	0	0	221	100	221
Total	3,085	25	782	5,804	63	3,668

Source: JICA Study Team

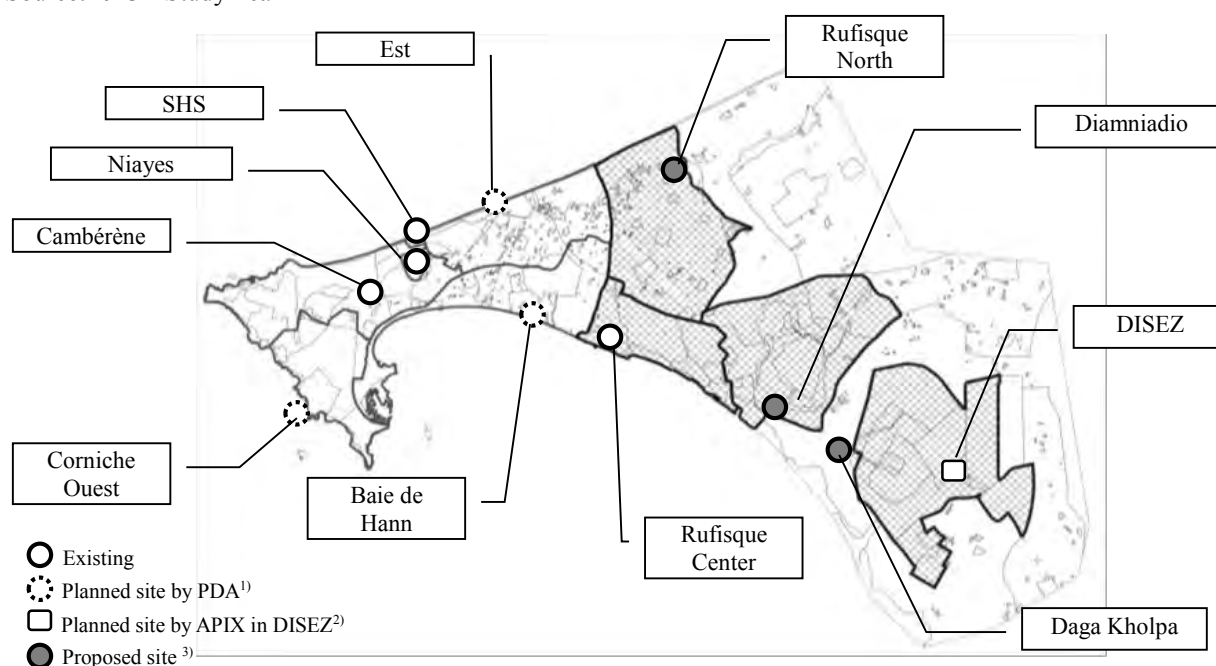
Development Plan

The required capacity of sewerage treatment plants (STPs) is estimated at 141,960 m³ per day in 2025 and 371,260 m³ per day in 2035, respectively, as shown in Table 4.7. The locations of STPs are selected considering future land use, topographic conditions and required land area, as shown in Figure 4.3. The activated sludge process is adopted, since its process requires less than one-sixth of the land area compared with the lagoon process. Septage treatment facilities will be established within the sites of the sewerage treatment plants. The septage treatment capacities required will be 3,520 m³ per day in 2025 and 2,633 m³ per day in 2035, a reduction by 887 m³ per day as a result of a wider coverage of the sewerage system in 2035.

Table 4.7 Required Capacities for Sewerage Treatment

Sewered Area	Required STP Capacity (m ³ /day)			STP Capacity Achieved by PDA by 2025 (m ³ /day)
	2013	2025	2035	
Cambérène	28,350	53,060	81,400	47,360
Baie de Hann	5,390	21,090	52,550	12,930
Corniche Ouest	27,010	37,990	70,400	19,560
Est	0	0	7,430	0
Niayes	400	740	870	875
SHS	490	500	590	595
Rufisque Center	1,030	9,520	38,600	0
Rufisque North	0	0	7,320	0
Diamniadio	0	16,000	85,500	0
Daga Kholpa	0	3,240	26,600	0
Total	62,670	141,960	371,260	81,320

Source: JICA Study Team



Source: 1) PDA
 2) APIX
 3) JICA Study Team

Figure 4.3 Existing, Planned and Proposed Location of the STP

4.6 Solid Waste Management

Objectives

- To create an environmentally-sound living condition for the people, free from unsanitary conditions caused by littering, the inadequate collection of garbage and open dumping at landfill sites
- To enhance the sustainability of solid waste management by promoting the 3Rs (Reduce, Reuse, Recycle) and introducing a proper intermediate waste treatment system

Development Strategies

- To promote waste reduction and separation at source
- To increase the service coverage area of waste collection and transportation
- To introduce a proper intermediate waste treatment system

- To safely close the Mbeubeuss landfill and open a sanitary landfill as well as reopen the Sindia landfill
- To place a higher priority on public involvement and consultations in all the processes of waste management
- To strengthen institutions and legislation through adequately securing financial and human resources to ensure a long-term strategic approach, as well as organizing legislation on such issues as environmental standards and illegal dumping control

Development Target

Waste collection rates will be improved from 67 % in 2015 to 76 % in 2025 and 88 % in 2035.

Demand Forecast

The amount of collected domestic waste is estimated at 1,837 tons in 2015, 2,796 tons in 2025 and 3,935 ton in 2035, respectively, as shown in Table 4.8.

Table 4.8 Future Forecast of Waste Generation Amount in the Study Area

Item (Unit)	2015	2025	2035
Population (person)	3,467,634	4,775,824	6,084,000
Unit waste generation rate (kg/day/person)	0.53	0.59	0.65
Waste generation amount (ton/day)	1,837	2,796	3,935

Sources: *Incoming Waste at Mbeubeuss Landfill*, CADAQ-CAR, 2014; JICA Study Team

Development Plan

The waste flow in the Study Area in 2025 and 2035 is shown in Figure 4.4.

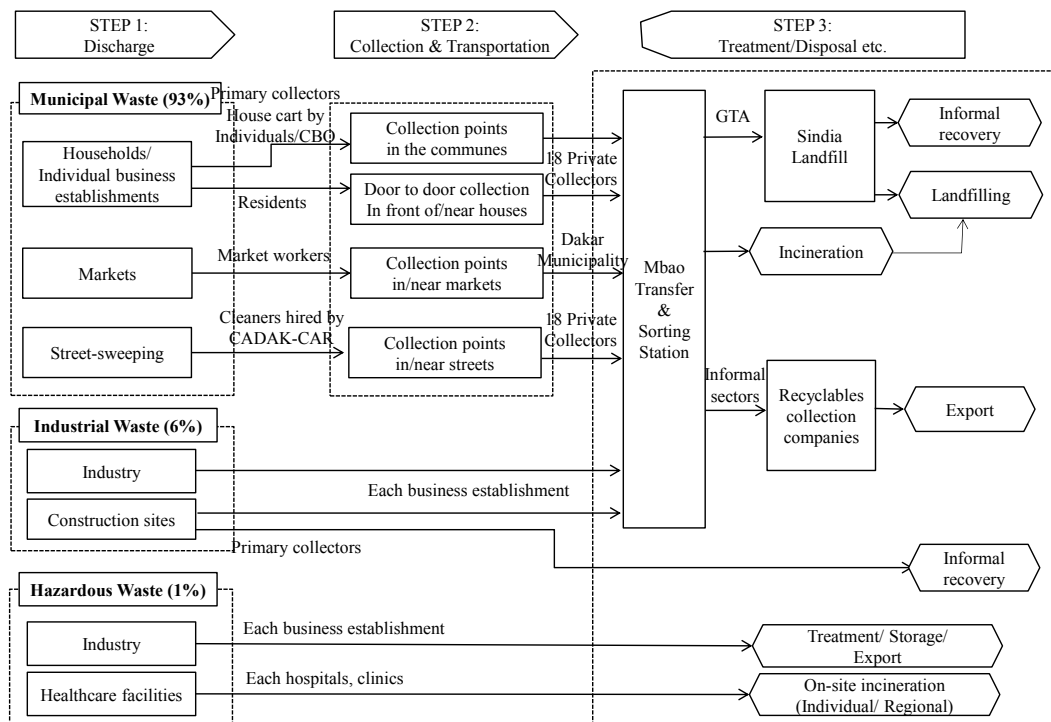
Municipal waste, including waste from households, markets and street sweeping, is collected and transported to the Mbaou transfer/sorting station, in which waste pickers hired by CADAQ-CAR will work on waste segregation for intermediate treatment. The segregated waste will be transported to the Sindia landfill by an outsourced private company.

For the collection and transport of waste, the following measures are proposed.

- 23% of household waste is fine materials such as sand and soil. It is important to encourage the residents not to discharge the fine materials as waste. Source separation of recyclable waste will be essential, so that the recycling system can be more easily managed in the future.
- The collection efficiency should be improved from 67% to 88%. As planned in the National Program on Waste Management, the introduction of collection points at district level is one of the options that helps to save waste collection time.

As of 2015, the Mbeubeuss landfill was the only existing dumping site in the Dakar region, while there are two open dumping sites in the Thiès and Mbour departments. These sites are planned for closure, once new sanitary landfills are opened in the Sindia and Tivaouane *communes*; the former will accept waste from the Dakar region and the Mbour department, while the latter will receive waste from the Thiès department.

As one of the options for meeting the needs of waste reduction and extending the life expectancy of landfill sites, an incineration system should be considered to reduce the waste to 1/10 on a weight basis and 1/20 on a volume basis.



Source: JICA Study Team

Figure 4.4 Waste Flow in the Study Area in 2025 and 2035

4.7 Electricity and Renewable Energy

Objectives

- To ensure access to a reliable and stable electricity supply for the entire population in the Study Area

Development Strategies

- To enhance the electricity supply capacity and improve supply reliability through expansion of small-scale diesel-powered facilities, increased electricity imports, renewal of aged power facilities, expansion of nationwide trunk transmission lines, construction of medium-scale coal-fired and/or gas-fired thermal power plants, gradually replacing diesel-powered generation facilities, and pursuance of the optimal “Energy Mix” and its implementation
- To reduce high electricity prices through a government-mandated setting of low electricity prices, improvements in the fare collection system, a shift to lower-cost power resources and reformulation of the electricity pricing system in order to control electricity consumption
- To expand the electricity distribution capacity in built-up areas in Dakar city
- To develop electricity supply infrastructures in new development areas
- To promote organizational reform of SENELEC with chronic deficits
- To increase renewable energy use, such as PV, hydro-power generation, and waste to supply the energy system

Development Target

The development targets are defined as shown in Table 4.9 below:

Table 4.9 Development Target for Electricity Supply

Item	2013	2025	2035
Electrification ratio in the Study Area (%)	90	95	99
Ratio of diesel generation (%)	90	20	5
Contribution by renewable energy (%)	small	15	15
Cost of generating electricity (FCFA/kWh)	170-190	55	55

Source: JICA Study Team

Demand Forecast

Following the estimated economic framework, the electricity demand is estimated at 348 MW in 2013, 838.3 MW in 2025 and 1,810 MW in 2035, respectively.

Development Plan

The electricity demand will be fulfilled in 2025, if the planned power plants, such as Sendou-1, Sendou-2, Jindal and others in Senegal, are realized with the supplemental supply by imported electricity from neighboring countries. The government and the SENELEC will need to ensure the further supply of electricity after 2025 by independent power producers (IPPs).

4.8 Urban Disaster Risk Reduction

Objectives

- To minimize disaster risk in order to create a comfortable environment and promote sustainable urban development

Development Strategies

(Overall Disaster Risk Reduction)

- To enhance the capacity against disaster risk by promoting a culture of disaster risk reduction, the preparation and implementation of contingency plans, and the development of an information-sharing systems for disasters
- To identify potential hazardous areas, that are under a threat of flood, costal erosion, and high tide, and reflect them in the land use plan for the urban expansion area in order to minimize future investment for hazard mitigation. The hazardous areas under a threat of high tide should be identified, taking into consideration the impacts by climate change in the long term

(Flood Hazard)

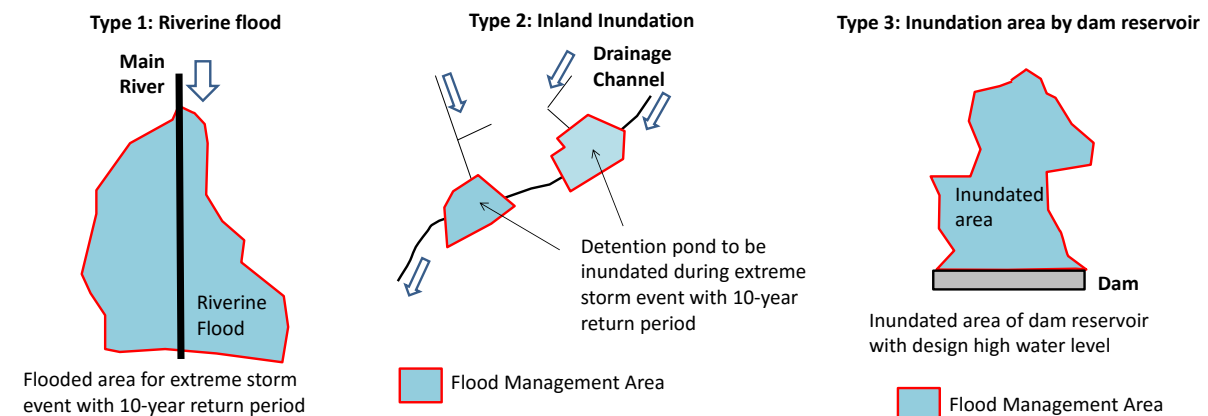
- To designate flood management areas where flood hazard is expected to be severe and regulate new developments in these areas in order to prevent further increase in disaster risk
- To cope with flood disaster risk by non-structural measures, such as hazard-mapping and early warning
- To mitigate flood hazard in urbanized spaces, except for the flood management area, up to a certain safety level by structural measures that utilize the effect of natural/artificial detention as much as possible

(Coastal Hazard)

- To strengthen coordination among urban development sectors and coastal management bodies in order to promote the regulation of development along the shoreline and optimum countermeasures against coastal hazards, as well as consider environmental conservation

Development Plan

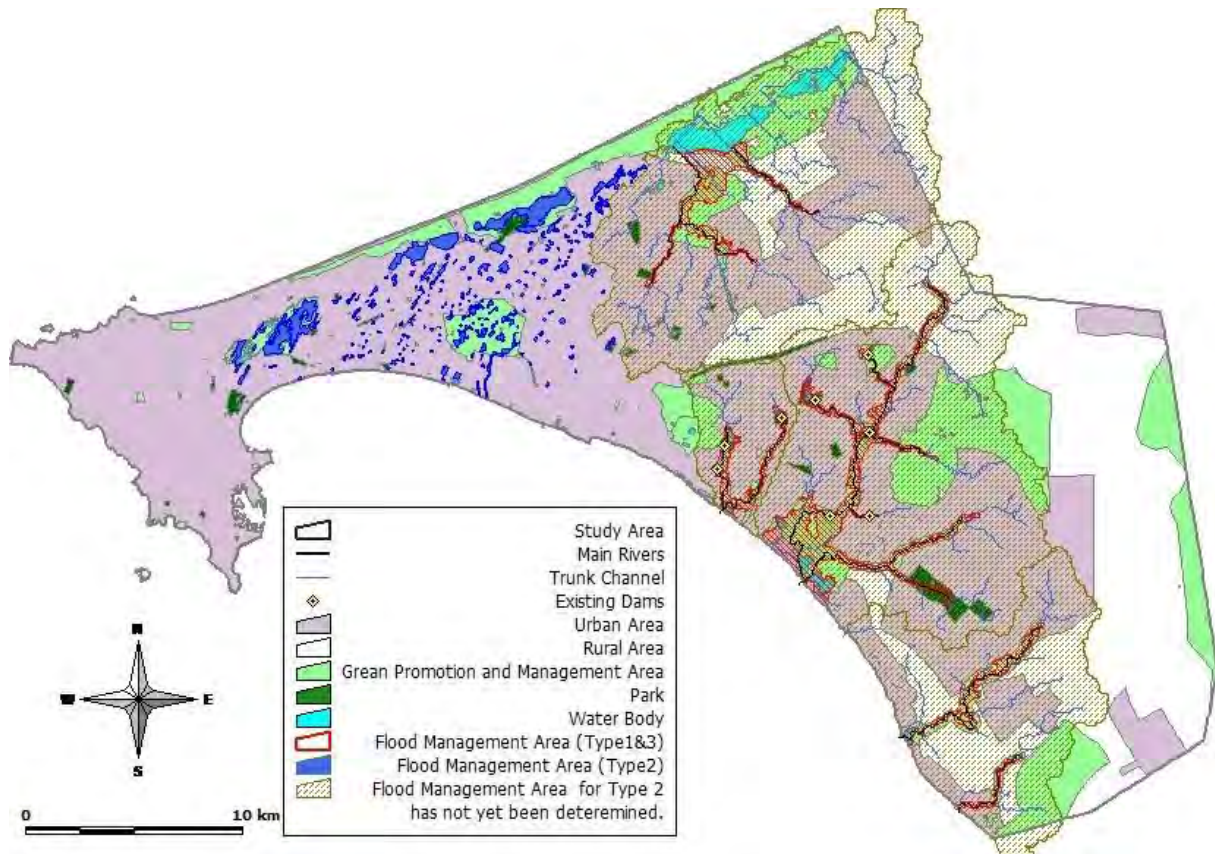
As shown in Figure 4.5, three types of inundation areas were identified: (i) the areas flooded by main rivers, (ii) the urbanized inland inundation areas with a 10-year return period, and (iii) the inundation area of the dam reservoir. The identified inundation areas are designated as a Flood Management Area, in which new development should be regulated to prevent an increase in flood risk. If an inundation area is already urbanized, it is designated as a Controlled Area for Flood Management instead. Residents should be informed of the flood hazard, while stakeholders in the controlled area should be involved in discussions about how to reduce the risk depending on the magnitude of hazard. Regulations should be in place in order to reduce flood risk, such that new construction should only be permitted if the structure is flood-proof, as well as to promote voluntary resettlement. A Flood Management Area and a Controlled Area for Flood Management are set as a guide for more detailed land use plans, such as the PUD, as shown in Figure 4.6.



Source: JICA Study Team

Note: If significant flooding caused by raised groundwater level is identified, which could occur in special geological conditions such as limestone, it could also be designated as a Flood Management Area.

Figure 4.5 Three Types of Flood Management Area



Source: JICA Study Team

Figure 4.6 Distribution of Flood Management Areas

Furthermore, such non-structural measures as preparation for and distribution of a flood hazard map and for early warning are proposed.

A flood hazard map shows the expected area flooded by the main river and the inland inundation area within the urbanization area during an extreme storm event with a 10-year return period, or even more severe, assuming the current condition of the land use as well as the existing flood control/drainage facilities. It should be prepared and disseminated to all relevant organizations and populations, to enhance awareness of the existing danger of flooding.

According to the National Civil Aviation and Meteorological Agency of Senegal (ANACIM), most heavy rainfall events in the rainy season are caused by the cumulonimbus system moving from east to west. The movement of storms could be monitored by enhanced meteorological observation. Such information could be used for early warning of flooding in the Study Area.

For the new urban area in Rufisque and Thiès, it is proposed that the urban drainage scheme should be planned according to the guiding principles specified in box below:

**Proposed Guiding Principle for an Urban Drainage Scheme
for the New Urban Expansion Area in Rufisque and Thiès**

- A natural drainage course with a catchment area of 1-10 km² should be utilized as the trunk channel, which should essentially be an open channel
- Where the trunk channel is located in a Green Promotion and Management Area, the channelization should be minimal so as to utilize the natural detention effect around it. The expected flooding area around the trunk channel in the Green Promotion and Management Area should be designated as a Flood Management Area
- Natural depressions should be utilized as detention ponds as much as possible in order to minimize the channel size, as well as to reduce peak discharge in downstream reaches, a basic concept in the PDD/PROGEP
- The secondary channel could be a closed conduit and follow road networks, but storm water should generally be drained by gravity in consideration of topographic conditions
- The main drainage facilities should have a buffer zone around them for easy maintenance and reserve some space for installation of other public facilities in future
- Where the drainage channels cross a road, enough discharge capacity should be secured

The coastal protection and management area is designated in the proposed land use plan. The urban development authority should coordinate with the coastal management bodies, such as the Department of Environment and Classified Establishments (DEEC), to establish a framework for coastal protection and management. The preparation of a comprehensive coastal management plan for (i) Corniche, (ii) Grande-Côte and (iii) Petite-Côte is proposed, in order to establish a framework for joint efforts between these authorities.

4.9 Magnitude of Investment Requirement

The magnitude of the total investment requirement to realize the 2035 Master Plan is estimated to be FCFA 7,255 billion in total, comprising FCFA 4,670 billion to be financed by the private sector and FCFA 2,555 billion to be borne by the government as shown in Table 4.10.

Table 4.10 Magnitude of Investment Requirements to Realize the 2035 Master Plan

Sector	a. Total Investment Requirements for 2035 Master Plan (FCFA Million)	b. Potential Amount of Private Sector Financing (FCFA Million)	c. Investment Requirement for the Government (FCFA Million) <i>a-b</i>
1. Urban transport	2,594,619	2,008,200	586,419
2. Logistics	552,059	270,000	282,059
3. Water resources and water supply	401,140	101,525	299,615
4. Sewerage and sanitation	14,486	50	14,436
5. Solid waste management	129,000	115,500	13,500
6. Electricity and renewable energy	3,174,000	2,204,553	969,447
7. Urban disaster risk reduction	390,000	0	390,000
Total	7,255,304 <i>100 %</i>	4,699,828 <i>65 %</i>	2,555,476 <i>35 %</i>

Source: JICA Study Team

CHAPTER 5 STRATEGIC ENVIRONMENTAL ASSESSMENT

5.1 SEA Procedure

A strategic environmental assessment (SEA) for the 2035 Master Plan was conducted by a Senegalese consultant, based on the terms of reference for the Strategic Environmental Assessment (SEA) officially, and submitted to and validated by the Department of Environment and Classified Establishments (DEEC), which is the official procedure stipulated by Senegalese law. The following section presents a summary of the SEA report submitted by the aforementioned Senegalese consultant.

The following subjects are presented:

- Comparison of different spatial development scenarios
- Evaluation of detailed urban plan candidate site
- Evaluation of the impacts of development strategies and spatial organization proposed by the 2035 Master Plan
- Enhancement measures for positive impacts and suppression, reduction and mitigation measures for negative impacts

5.2 Evaluation and Comparison of Spatial Development Scenarios

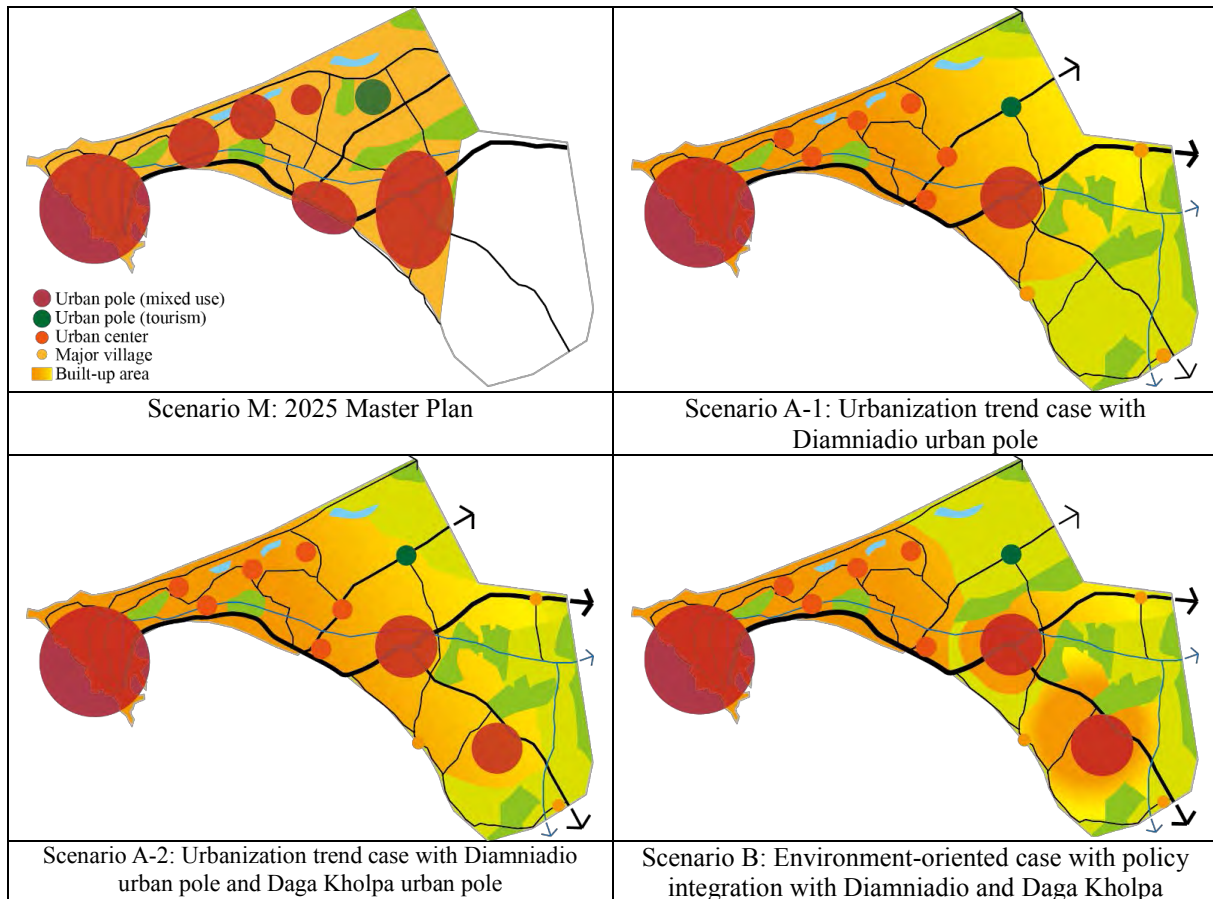
Within the framework of the upgrading of the Master Plan for Dakar, three scenarios of development are envisaged in addition to the existing 2025 Master Plan. In spite of the differences in ambition, they all plan to build a multipolar urban structure. The urban poles are defined as zones sheltering urban activities, in particular business and commercial activities as well as public services at national, regional and urban levels.

This common aim was already presented in the 2025 Master Plan, but it acknowledged the encroachment of urbanization on the Niayes area and did not clearly define the functions, limits and land needs of every urban pole.

The new aspect of this stated ambition is that every urban area will have a compact built-up area and be surrounded by a green belt to curb urban sprawl.

In terms of the alternatives on the spatial structure, as shown in Figure 5.2.1, scenario B has several similarities to scenario A-2. It retains an urban structure model based on three poles, while insisting on the preservation of environment and farmland, and offers real levers to stop the urbanization frontier moving towards these protected areas. It proposes to make Niayes a green belt connected to the classified forests, thereby reserving an important place for green spaces inside the urban poles.

Scenario B has several advantages over other planning scenarios. It offers a balanced development with a multipolar structure and includes measures to protect the environment.



Source: JICA Study Team

Figure 5.1 Spatial Structure Alternatives of the 2025 Master Plan and the Three Development Scenarios

5.3 Evaluation of the Impacts of Development Strategies according to the 2035 Master Plan

The development strategies are proposed in the 2035 Master Plan based on the Scenario B. The proposed development strategies are evaluated from the following perspectives.

- Quality of surface water and groundwater
- Air quality and quietness of population
- Biodiversity conservation
- Access to basic social services (health, education, transport, communication etc.)
- Ecological value of the site
- Level of soil erosion
- Soil quality and pollution
- Landscape quality and quality of life of populations (quietness, space etc.)
- Land use (agriculture, livestock, housing etc.)

The following table shows the overall summary of the results of the assessed impacts of all the aspects of the 2035 Master Plan regarding the adopted criteria.

Table 5.1 Overall Summary of Results of Impact Assessment of 2035 Master Plan

		Development Strategies / Spatial Organization					
		Economic development strategy	Strategy and spatial organization of Infrastructure Development	Strategy and spatial organization of urban development	Strategy for environmental management	Strategy for social development	Risk management strategy related to urban disasters
Adopted Criteria	Quality of surface water and groundwater	B-	A+	B-	A+	D	D
	Air quality and quietness of populations	C+	A+	B+	A+	D	B+
	Biodiversity conservation	B-	C-	B-	A+	B-	A+
	Access to basic social services	B+	B+	A+	C+	A+	D
	Ecological value of the site	B+	C+	B+	A+	C+	A+
	Level of soil erosion	D	C+	C+	A+	D	B+
	Soil quality and pollution	C+	A+	A+	B+	D	D
	Landscape quality and quality of life	B+	B+	B+	B+	D	B+
	Land use	B+	C-	C±	A+	C+	D

Legend: A+/-: Remarkably positive or seriously negative impact is predicted
 B+/-: Positive or negative impact is expected to some extent
 C: Extent of the impact is unknown (a further examination is needed and the impact might be defined as the study progresses)
 D: Impact is very small or nil and a further survey is not required

5.4 Mitigation and Amplification Measures

The following mitigation and amplification measures are proposed for the factors that might generate some adverse impacts on the environment:

Economic Development Strategy

- To strictly oblige industries to follow the Sanitation Law in relation to industrial wastewater quality to mitigate pollution of the soil and groundwater
- To promote reuse of treated wastewater for agriculture
- To implement a policy to limit the emission of smoke from factories
- To allocate sufficient space for natural green spaces to preserve biodiversity
- Infrastructure development strategy
- To allocate natural and reforestation area around the new solid waste disposal site

Urban Development Strategy

- To preserve the watershed area in a natural condition to ensure continued charging of surface water and groundwater
- To allocate a natural area to the new urban area to preserve biodiversity

Social Development Strategy

- To provide natural space and amenities around the planned university and hospital for Diamniadio
- To preserve agriculture areas

CHAPTER 6 DETAILED URBAN PLAN FOR DAGA KHOLPA

6.1 Selection of Target Area for Detailed Urban Plan Preparation

Preparation of a detailed urban plan (Plans d'Urbanisme de Détails: PUD) is an effective tool to realize the Master Plan. It is becoming increasingly important to prepare PUDs in the areas where rapid urbanization is posing a risk of disordered and uncontrolled urban development. The aim of this Study in undertaking a detailed urban plan is to create a successful model for controlling urban development through PUD preparation and implementation. It will be the task of the DUA to disseminate the successful model to other cities in Senegal.

A number of target areas for a detailed urban plan was identified through analyses of data and information and discussions with the DUA. A number of criteria was formatted into a score sheet, as shown in Table 6.1, in order to select one target area for preparing a detailed urban plan. The selection criteria comprise criteria related to overarching principles, development potential, regulatory and territorial planning, and capacity development.

The Daga Kholpa area was selected as the target area with the highest score of 12 points.

Table 6.1 Selection Criteria and Result of Scoring

Selection Principles	Selection Criteria	Dakar New City	Daga Kholpa	Diamniadio	New Dakar City	Pikini Urban Center	Rufisque	Diacksao Bambilori	Deny Birame Ndao	SODIDA	Yenne
Overarching Principles											
In line with the PNAT long-term vision	Promoting decentralization (enhancing urban management in suburban area)		x	x		x	x	x	x		x
In line with the SRAT long-term vision	Strengthening the regional structure		x	x			x				x
In line with the long term-vision and goals of the Dakar 2035 Master Plan	Promoting Dakar PDU	x	x	x	x	x	x	x	x	x	x
Development-Related Criteria											
Supporting actions already initiated by the government of Senegal		x	x	x	x	x				x	x
Responding to a real and urgent need for a detail plan			x					x	x		x
Setting the pace for new development trends		x	x	x	x	x	x			x	x
Promoting of new economic activities (ICT, logistics platforms etc.)		x	x	x	x	x					x
Promotion of new urban areas for population growth			x	x			x	x	x		x
Upgrading existing urban areas		x			x	x	x			x	
Control-Related Criteria											
Absence of an approved PUD			x			x	x		x		x
Reducing encroachment on farms (tackling sites with critical issues in terms of development control, protection of areas facing imminent development pressure, controlling urban sprawl and land speculation)								x	x		
Improvements to disaster prevention and strengthening urban resilience			x				x				
Promoting Capacity Building and Local Communes' Involvement											
Capacity building of the DUA (Replicating experience to other communes)			x	x		x	x	x	x		x
Usefulness of urban management to local government			x	x			x	x	x		x
Score		5	12	9	5	8	10	7	8	4	11

Source: JICA Study Team

6.2 Development Concept for Daga Kholpa

(1) Development Concept for Daga Kholpa Prepared by the DUA

The DUA prepared a preliminary planning concept for Daga Kholpa (Figure 6.1), consisting of a broad subdivision of different large blocks structured by a hierarchized road network and spatially distributed zones, with a preliminary allocation of public facilities and large facilities. The planning concept covers Daga Kholpa, the new international airport (Aéroport International Blaise Diagne: AIBD), Kirene and Yene. Within this distribution, existing villages and settlements were preserved within a growth boundary that was established for their future extension. The housing zone is divided into a collective housing area accounting for 60%, while a high-end housing projects area accounts for the remaining 40%. In addition, the concept plan designates industrial and handicraft production zones, artistic handcrafting zones, agricultural zones, tourist zones, zones for collective equipment and facilities, and protected green zones and public spaces.



Source: Esquisée du plan d'aménagement de Daga Kholpa, DUA, 2015
: Daga Kholpa Area

Figure 6.1 Daga Kholpa Schematic Zoning Concept

(2) Development Concept, Vision and Role

The general vision and future role of the Daga Kholpa development area in the framework of the vision for the 2035 Master Plan are as follows:

- To help balance the growth of the city of Dakar
- To complement AIBD activities
- To support the growth of the Diamniadio urban pole

Daga Kholpa has significant strategic importance due to its proximity to the newly developed airport, which represents a rare opportunity in terms of development choices, especially given the inherent potential the airport could generate and sustain, not only in its immediate vicinity but also at both the city and the sub-regional levels.

Accordingly, the Daga Kholpa area needs to attract specific functions and businesses that are deemed important to sustain the airport's activities. Consulting closely with the DUA, the following specific functions are proposed:

Central Business District (CBD)

- Administration buildings and public services
- Company headquarters
- Hotels
- Supporting services and amenities
- Prestigious schools
- Residential buildings
- Green Parks, open spaces etc.

Business Parks

- ICT centers for outsourcing IT and business processes
- Business incubators
- Regional cloud server for West Africa
- Supporting services, amenities etc.

Industrial and Logistics Zone

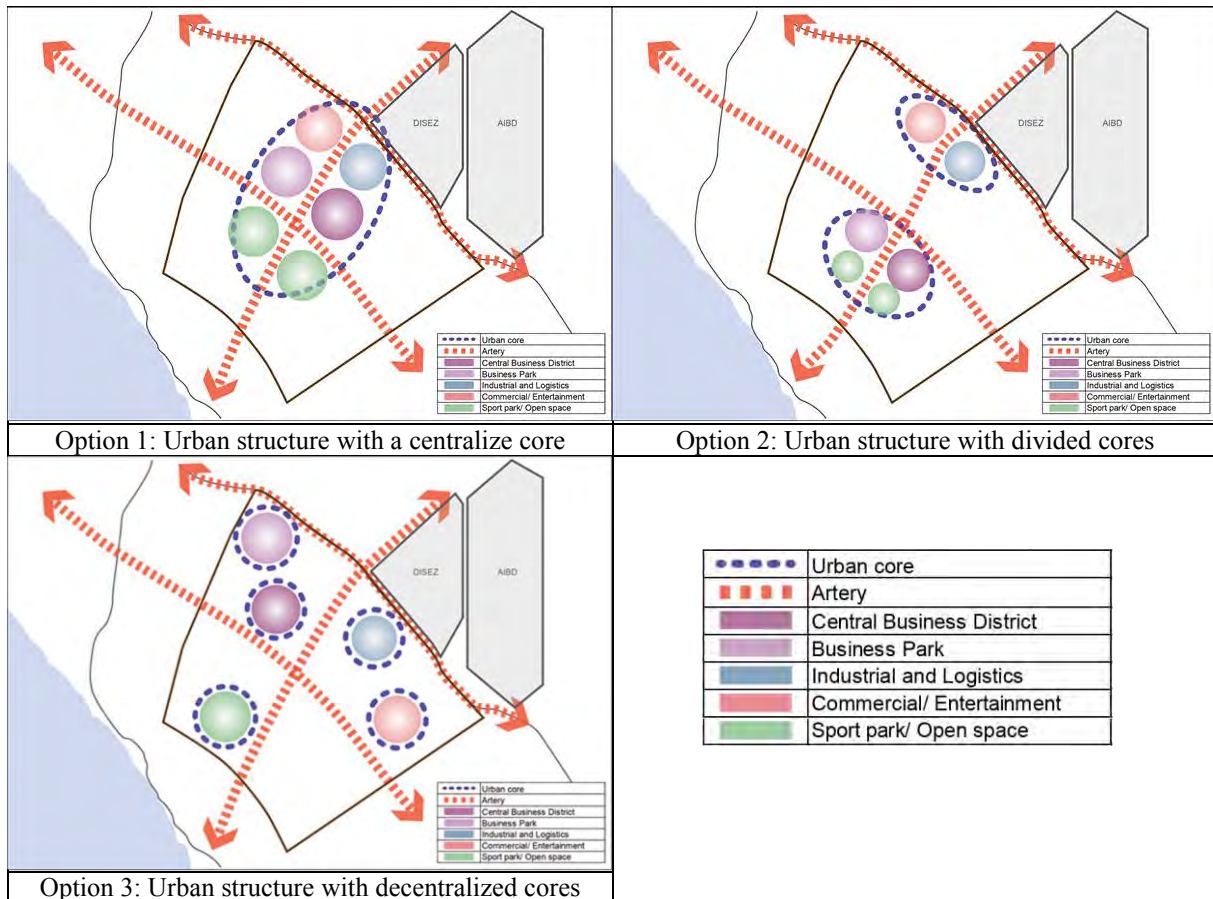
- Light industries (industrial packaging, repackaging, conditioning)
- Flow-through and e-fulfillment facilities
- Wholesale merchandise display etc.

Large Economic Activity Zone/Wholesale and Entertainment

- Shopping mall serving Dakar, AIBD and the adjacent areas
- Theme park
- International fairground etc.

(3) Proposed Urban Structure

Given the ideas of the proposed functions, three options of urban structure were analyzed by the DUA and the JICA Study Team. The proposed options show the possible layout of urban cores consisting of a CBD, a business park, and industrial and commercial functions. Option 1 shows the urban cores allocated between trunk roads in an east-west direction, while Option 2 depicts the urban cores separately located along those trunk roads. Option 3 indicates a case in which the urban cores are widely dispersed in the Daga Kholpa area. The preliminary concept by the DUA falls under Option 3. A strategic environmental assessment was carried out to evaluate these options. As a result, Option 1 was selected as the most preferable urban structure to create a distinct and compact urban core.



Source: JICA Study Team

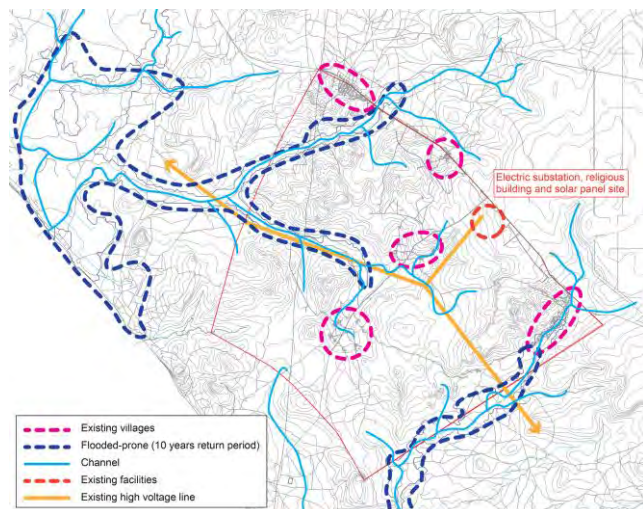
Figure 6.2 Alternative Urban Structures for the Daga Kholpa Area

6.3 Land Use Plan for 2035

Assumptions and Considerations

Preparation of the plan for land use in Daga Kholpa by 2035, to be presented later, was based on the following assumptions and considerations:

- Estimated populations of 78 thousand in 2025 and 184 thousand in 2035 are assumed.
- Areas for development are planned in areas suitable for development, while those unsuitable for development are avoided, such as flood-prone areas, existing settlements and surrounding areas for future expansion, and along the existing high voltage power transmission lines and their rights of way (22 meters on both sides), as shown in Figure 6.3.



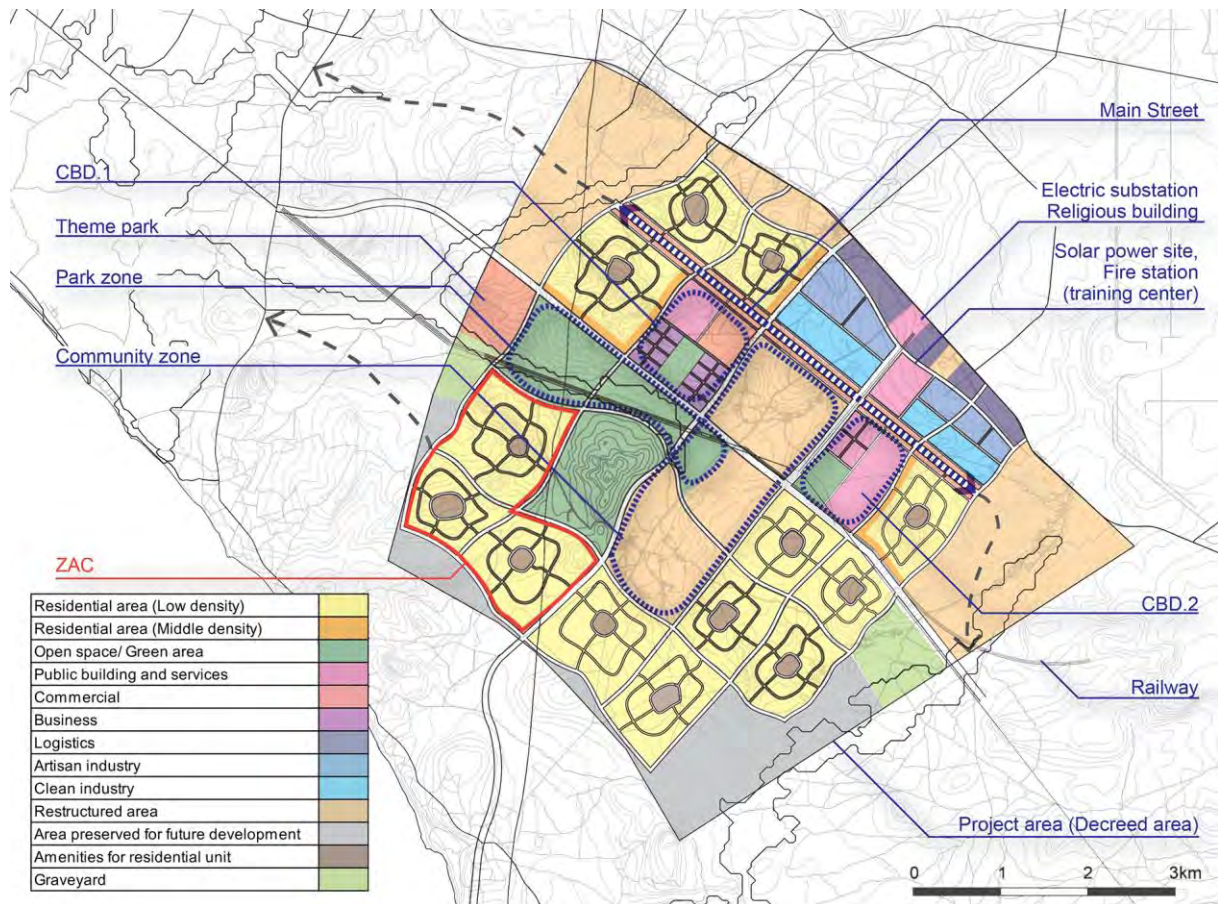
Source: JICA Study Team

Figure 6.3 Areas Unsuitable for Urbanization

- The target ratios of land use are assumed as a maximum of 70% for residential areas, a minimum of 15 % for public services and a minimum of 15 % for roads.
- The roads are aligned in such a way as to make them as straight as possible, minimizing slopes and making the junctions have right angles, while following topographic conditions.
- The housing plot sizes are assumed to be 200 m², 300 m² and 500 m².

Proposed Land Use Plan for 2035

The land use plan for Daga Kholpa in 2035 is presented in Figure 6.4 below. The land use ratios are shown in Table 6.2.



Source: JICA Study Team

Figure 6.4 Proposed Land Use Plan for Daga Kholpa by 2035

Table 6.2 Proposed Land Use Ratio of Daga Kholpa

Land Use	Land Use in Detail	Area (ha)	Ratio (%)
Residential area		1,265	49
Publicly used facilities	Open space, green area	319	13
	Public buildings and services	128	5
	Commercial and business	176	7
Road		439	17
Logistics		238	9
Sub Total		2,565	100
Restructured area	Reorganization of the land uses and improvement of the infrastructures in the existing villages and surrounding areas including farm lands	916	-
Other areas	Cemetery, reserved area for future development	410	-
Total (Project area)		3,891	-

Source: JICA Study Team

Its main characteristics are summarized as follows:

- The road network consists of the three inter-city arterial roads. The network includes: the existing national road Number 1 (N-1) and another running in a northwest-southeast direction, which run parallel in the south; the northeast-southwest road leading to the AIBD and the motorway; the main street running in between and in parallel with N-1 and the northwest-southeast artery, which is more oriented towards pedestrians for shopping and strolling and public transport such as the BRT; and the circulation roads to distribute people and goods within Daga Kholpa.
- A business and commercial area is allocated to the south of the main street, which constitutes the center of Daga Kholpa.
- A green space is secured in the western-middle part in the flood-prone area and its surroundings, not only to avoid developments in the unsuitable areas, but also to provide adequate natural space for recreation and relaxation for the people.
- The existing villages, its surroundings and the existing road are preserved for future restructuring as the community zone.
- A sports park planned at the eastern/northern corner of the green area is to provide opportunities for local people and new residents to engage with each other through sports.
- Logistics and light industries are allocated mainly along N-1; in consideration of land demands that are expected to quickly increase in accordance with the AIBD development.
- A theme park is located at the middle-west area along the northwest-southeast artery, welcoming people from the Diamniadio direction as the face of Daga Kholpa.
- Two graveyards are planned at the eastern and western ends of the southern inter-city artery road for Muslims and Christians.

Residential Area

Each neighborhood unit is planned to function as a self-supporting unit with an amenity zone, where such facilities as shopping centers, schools, health centers and parks are located. A primary school will be established for every 10,000 per head of population and a secondary school for every 20,000 per head of population.

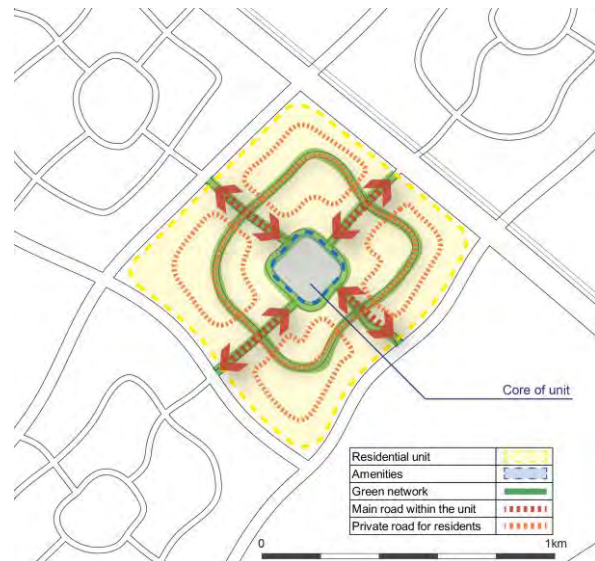
A cul-de-sac road network is proposed, as shown in Figure 6.5, in order to create a comfortable and secure living environment by limiting the access of through-traffic into the residential units.

Infrastructure Demands

Infrastructure demands are estimated to be 20 MW for electricity, 15,325 m³ per day for water supply and 14,963 m³ per day for sewerage.

Magnitude of Investment

The magnitude of investment is preliminarily estimated as a broad indication, as shown in Table 6.3 below.



Source: JICA Study Team

Figure 6.5 Example of Neighborhood Unit

Table 6.3 Magnitude of Investment

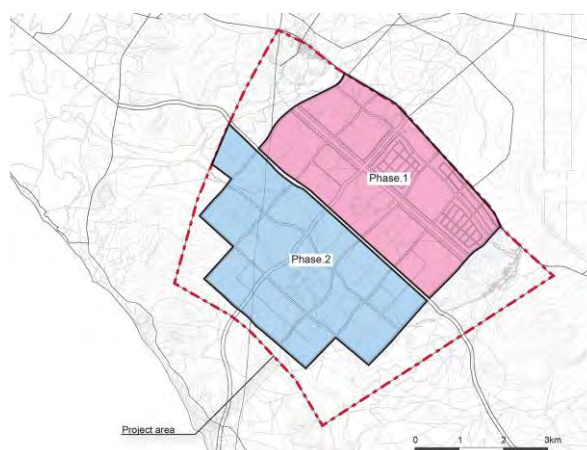
Item	Cost in FCFA Million	Cost in US\$ Million
Infrastructure (public investment)	247,391	416
<i>Cost per hectare</i>	<i>63.6</i>	<i>0.11</i>
Sub-division (private investment)	227,623	383
<i>Cost per hectare</i>	<i>58.5</i>	<i>0.10</i>
Total	475,014	800
<i>Cost per hectare</i>	<i>122.1</i>	<i>0.21</i>

Note: The values for cost per hectare are estimated on the basis of 3,891 hectares as the Project Area.

Source: JICA Study Team

Phasing

The northeastern part could be developed in the first 10 years until 2025, taking advantage of its proximity to the airport and the autoroute along the existing N-1. Preparation of key infrastructures needs to proceed in this phase. The remaining part could be developed in the second phase (2025-2035) in accordance with the completion of the key infrastructures initiated in Phase 1.



Source: JICA Study Team

Figure 6.6 Phasing

Implementation Arrangement

There are three options for an institutional set-up to manage various technical, administrative and financial matters for implementing the Daga Kholpa project: (i) a publicly-managed agency with special delegation, (ii) a public-private partnership (PPP) and (iii) an independent development agency.

The government of Senegal will have to analyze the advantages and disadvantages of each approach and select the most desirable option.

6.4 Strategic Environmental Assessment

A strategic environmental assessment (SEA) was conducted for the Daga Kholpa Detailed Plan by a Senegalese consultant in line with the law in Senegal. The major results are summarized below. The three alternatives for urban structure were assessed from the environmental perspective as indicated below. The SEA judges Option 1 as the optimal alternative.

Table 6.4 Comparison of Urban Structure Alternatives

Alternatives	Advantages	Disadvantages
Centralized core	<ul style="list-style-type: none"> • Minimization of trips, thus lower carbon footprint • Social diversity 	<ul style="list-style-type: none"> • Closeness of potentially harmful activities, such as industry, to residential areas
Divided cores	<ul style="list-style-type: none"> • Protection of living environment against potential disturbances generated by industrial activities 	<ul style="list-style-type: none"> • Increase of trips, therefore higher carbon footprints • Reduced social control, increased delinquency and sense of insecurity in industrial and business areas during nighttime
Decentralized cores	None	<ul style="list-style-type: none"> • Lack of a sense of urban hospitality • Difficulty for residents in enjoying services dispersed across various locations • Increased trips, therefore higher carbon footprints

Source: JICA Study Team, based on SEA Report in the Daga Kholpa PUD

Possible impacts of development

The SEA identified possible impacts of development, as shown in Table 6.5.

Table 6.5 Results of the Impact Assessment of the Daga Kholpa PUD

Factors	General Impact	Comment
Quality of surface water and groundwater	C-	<ul style="list-style-type: none"> • Impact on groundwater resources will be limited • Contamination could occur unless proper sewerage system is introduced • Storm drainage management needs to be considered, taking into account the sizing of drainage pipes and artificial surfaces
Air quality and quietness of populations	B-	Relatively negative impact will be observed considering that air is currently extremely pure in the area
Biodiversity conservation	C-	<ul style="list-style-type: none"> • Biodiversity will remain intact on the outskirts of the PUD area • The vast central park will allow the wildlife, cleared out by urbanization, to find refuge • The spatial organization close to north, south, and east does not favor the optimal transit of animals on a larger scale.
Access to basic social services (health, education, transport, communications etc.)	A+	<ul style="list-style-type: none"> • Access to social services, whether education or health, will be improved significantly • Numerous local services provided in residential units (shopping centers, schools, health centers and parks) will allow sufficient access of the population to all elementary social needs.
Level of soil erosion	C+	The orientation of the urban fabric and its roads following the level contours seems to fulfill this function of channeling rainwater and thus preventing any risk of erosion
Soil quality and pollution	C-	There might be a risk that the vast green space becomes a receptacle of some domestic waste without special controls or maintenance in place, resulting in soil pollution
Landscape quality and quality of life of populations (quietness, space etc.)	B+	<ul style="list-style-type: none"> • The development will lead to an improvement in living conditions for both new residents and the indigenous people • Residential and activity areas will not be affected by any floods under the proposed spatial organization • The parks and green spaces planned in a vast surface will provide a greatly improved living environment for future residents coming mostly from urban backgrounds • It may take a while for the local residents to accept the noise caused by increased traffic and construction works, which will disturb their tranquility and undermine the benefits of urbanization
Land use (agriculture, livestock, housing etc.)	B+	<ul style="list-style-type: none"> • The loss of agricultural land may destabilize neighboring markets and disrupt the habits of indigenous population in the short-term • In the long-term, it is possible that only current agriculture lands become the receptacle for urban extension of the two villages and that agriculture will disappear completely from the area • Urban development will bring many new land uses, such as residential (including social services, secondary and tertiary activities), reflecting that the impact of the development will be globally positive

Source: JICA Study Team, based on the SEA Report in the Daga Kholpa PUD

The following mitigation and amplification measures are proposed:

- Rainwater drainage should be well studied, in consideration of controlling the proportion of built-up surfaces of residential units and infiltration at the plot.
- Strategic places for water table recharge should be identified by a thematic map.
- The current high quality of the soil should be maintained by good domestic and industrial waste management, together with the strict application of environmental management and monitoring laws prior to any investment.

CHAPTER 7 PRE-FEASIBILITY STUDY FOR PRIORITY PROJECTS

7.1 Priory Projects Identified in 2035 Master Plan

7.1.1 Selection of Priority Projects

A project list is formulated in each sector’s development plan. From among the proposed projects and programs, those that meet the following criteria are selected as the priority projects:

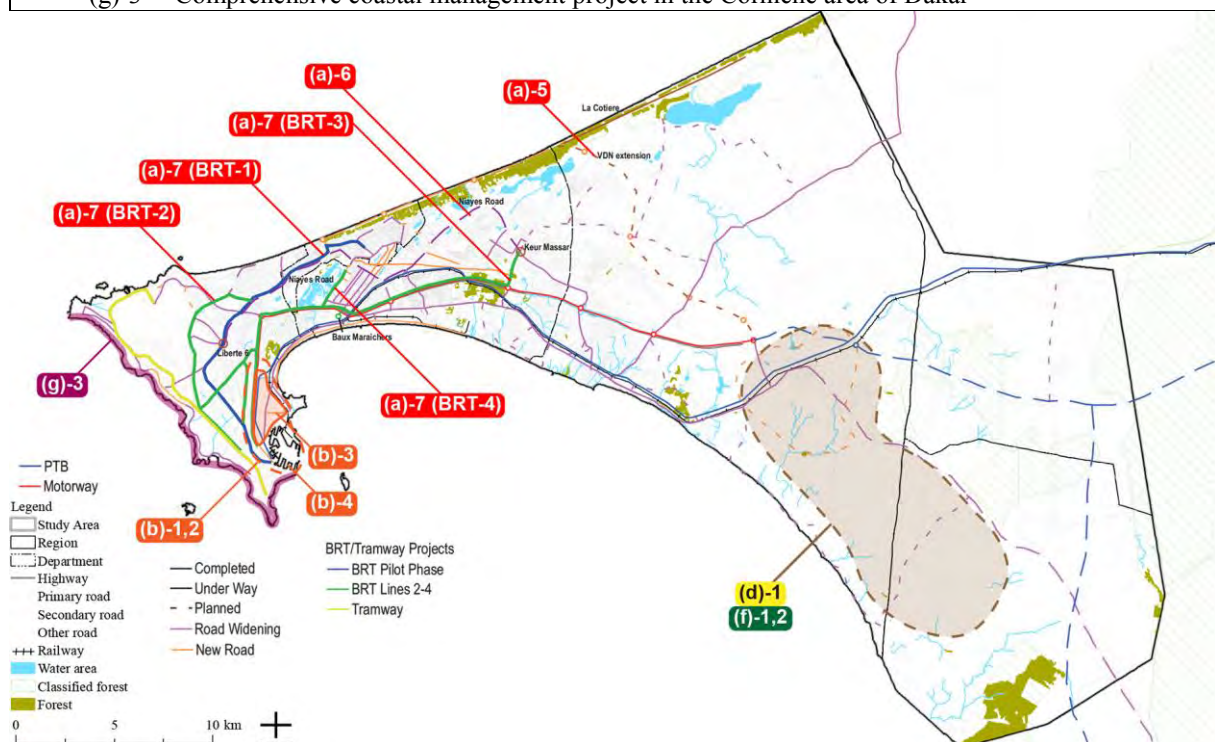
- (a) Consistency with national policy
- (b) Contribution to the realization of the vision, objectives and strategies of the 2035 Master Plan
- (c) Effects to achieve sustainable development, which contributes to improvements in the living environment in existing urban areas, the preparation of new urban areas to manage the population increase, the mitigation of heavy environmental deterioration and the enhancement of disaster prevention
- (d) Urgency
- (e) Absence of commitment by international partners

The projects thus selected are shown below.

Table 7.1 List of Priority Projects

(a) Transportation
(a)-1 Improvement of the Cité Keur Gorgui intersection, the SDE intersection and the Aimé Césaire intersection on VDN
(a)-2 Improvement of the Bourguiba intersection and the Khar Yalla intersection on Front de Terre Road
(a)-3 Improvement of the Kapa intersection, the Hann intersection, and the Pont d’Amitier and Thiaroye intersection
(a)-4 Access road improvement around the Baux Maraîchers bus terminal
(a)-5 Extension of VDN/development of “La Cotière”
(a)-6 Development of Niayes Road
(a)-7 BRT development
(a)-8 Rail-based mass transit development
(b) Logistic Infrastructure
(b)-1 Improvement of inland cargo transportation infrastructure (road)
(b)-2 Improvement of inland cargo transportation infrastructure (railway)
(b)-3 Development of logistic infrastructure
(b)-4 Strengthening of competitive advantage of Dakar Port
(c) Water Resources
(c)-1 Technical assistance for the preparation of the Integrated Water Resources Management Plan for the Study Area
(c)-2 Treatment of non-standard quality groundwater to counter the scarcity of water resources
(c)-3 Awareness campaign on water conservation to restrain water demands
(c)-4 Reduction of non-revenue water (NRW) to improve water supply efficiency

(c)-5	Use of Treated Wastewater for Non-domestic Purposes
(d)	Sewerage and Sanitation
(d)-1	Project to install a sewerage system in the strategic urban expansion area
(d)-2	Project to install and appropriately manage a septage treatment facility in the planned Est and Rufisque North sewerred areas
(e)	Solid Waste Management
(e)-1	Comparative analysis of proper waste treatment alternatives
(e)-2	Identification and construction of sanitary landfills
(e)-3	Promotion of the 3Rs
(e)-4	Introduction of a waste-to-energy system
(f)	Power and Renewable Energy
(f)-1	Installation of new substations and distribution systems in the new development area
(f)-2	Modernization of distribution management systems (DMSs) for the new development area
(f)-3	Technical aid project for the detailed study of transmission and distribution systems in the existing city areas of Dakar
(f)-4	Installation of a waste-to-energy power plant
(f)-5	Installation of “mega-solar-electricity” facilities at a communal public facility
(f)-6	Installation of wind power facilities
(f)-7	Installation of low-head hydropower plants in the Gambia River basin
(g)	Disaster Risk Management
(g)-1	Technical assistance project for capacity development on land use management emphasizing the Flood Management Area concept
(g)-2	Formulation of urban drainage master plans in the emergent urbanization areas in Rufisque and Thiès
(g)-3	Comprehensive coastal management project in the Corniche area of Dakar



Source: JICA Study Team

Note: Only those projects with specified locations are shown.

Figure 7.1 Location of Priority Projects for Realization under the 2035 Master Plan

7.1.2 Selection of Priority Projects for Pre-Feasibility Study

The candidate projects for a pre-feasibility study are selected from the priority projects, focusing on the following candidate infrastructure development:

- No overlap with donors or government agencies for implementation
- No serious environmental and social impact

The selected candidate projects are evaluated with a set of criteria that covers the following five aspects:

- (a) Consistency with national policy and the 2035 Master Plan
- (b) Urgent need: Severity of the problems is assessed; a higher score is given to a project that will solve problems apparently observed in existing conditions, while a lower score for a project corresponds with emerging problems
- (c) Maturity: A project is clearly recognized by the related agencies and prioritized in a sector development plan
- (d) Suitability for Japan's cooperation
- (e) Possibility of social problems

Table 7.2 shows the evaluation of eight candidate projects. While the comparative analysis of proper waste treatment alternatives focusing on a waste-to-energy system is a study project rather than an infrastructure project, it is included given the severity of the solid waste management issue in the Study Area. The highest score of 13 points is given to the comparative analysis of proper waste treatment alternatives focusing on a waste-to-energy system (e-1). The second highest score of 12 points is given to the improvement of the three intersections on VDN ((a)-1), the improvement of two intersections on Front de Terre Road ((a)-2) and the improvement of Baux Maraîchers ((a)-4).

The comparative analysis of proper waste treatment alternatives focusing on a waste-to-energy system is selected as a preliminary study to identify the best solution for improving solid waste management in the Study Area. The other three projects of the transportation improvement, (a)-1, (a)-2 and (a)-4, are selected as the priority projects for a pre-feasibility study in order to assess the viability of these projects from technical, environmental, economic and financial perspectives. The improvement of three intersections in (a)-1 and that of two intersections in (a)-2 are integrated into one package in the pre-feasibility study.

Table 7.2 Evaluation of Candidate Projects for Pre-Feasibility Study

Candidate Projects	Selection Criteria					Total Score
	Consistency	Urgent Need	Maturity	Suitability for Japan's Cooperation	Possibility of Social Problem	
Scoring criteria	3= high 2=medium 1=low					1=No problem 0= Problem may occur
(a)-1 Improvement of Cité Keur Gorgui intersection, SDE intersection, and Aimé Césaire intersection on VDN	3	3	3	2	1	12
(a)-2 Improvement of Bourguiba intersection and Khar Yalla intersection on Front de Terre Road	3	3	3	2	1	12
(a)-4 Traffic improvement at Baux Maraichers	3	3	3	2	1	12
(a)-7 BRT-2/BRT-3	3	3	3	1	1	11
(b)-4 Access improvement project around Dakar Port	3	2	2	3	1	10
(e)-1 Sewerage system in Diamniadio and Daga Kholpa areas	3	2	2	1	1	9
(e)-1 Sewerage system in Rufisque north area	3	2	2	1	1	9
(f)-1 Comparative Analysis of Solid Waste Treatment Alternatives Focusing on Waste-to-Energy System	3	3	2	3	1	13

Source: JICA Study Team

7.2 Intersection Improvement Project on VDN and Front de Terre Road

Locations of Intersections

Figure 7.2 shows a location map of the target area for the five (5) intersections under study. Station SDE, Cite Keur Gorgui and Aime Cesaire are the intersections located along VDN, whereas Khar Yalla and Bourguiba are located along the Front de Terre.



Source: JICA Study Team

Figure 7.2 Location Map of the Intersections

Traffic Volumes

Table 7.3 below presents traffic volumes of each intersection clarified by a series of traffic-related surveys. It is observed that these intersections suffer from heavy traffic congestion caused by structural

deficiencies or inadequate traffic management.

Table 7.3 Traffic Volume at Sub-Project Locations

Code	Location	Traffic Volume (PCU/16hrs)					Flyover/ Underpass Direction
		From north	From south	From east	From west	Total	
I-01	SDE	23,240	21,388	4,907	5,350	54,886	N-S
I-02	Cite Keur Gorgui	19,071	18,087	7,048	6,637	50,842	N-S
I-03	Aime Cesaire	10,769	8,883	5,138	5,328	30,117	N-S
I-04	Khar Yalla	2,820	3,429	8,158	6,874	21,281	E-W
I-05	Bourguiba	-	10,951	12,426	7,693	31,071	E-S / E-W

Note: Shaded cells indicate main traffic directions for which overpasses/underpasses are proposed as improvement alternatives.

Source: JICA Study Team

Alternative Solutions

A set of alternative solutions that would resolve the traffic congestion is established for further analyses, such as grade separation by flyover and by underpass and at-grade improvements, as shown in Table 7.4.

Table 7.4 Proposed Alternatives for Improvement

Sub-Projects	Alternatives		Types of Structure
SDE intersection improvement	I-01a	Flyovers on both sides	Grade separation
	I-01b	Underpasses on both sides	
	I-01c	Flyover in the center	
	I-01d	Underpass in the center	
	I-01e	At-grade improvement with traffic signals	At-grade
	I-01f	At-grade improvement with U-turn lanes	
Cite Keur Gorgui intersection improvement	I-02a	Flyovers on both sides	Grade separation
	I-02b	Underpasses on both sides	
	I-02c	Flyover in the center	
	I-02d	Underpass in the center	
	I-02e	At-grade improvement with traffic signals	At-grade
	I-02f	At-grade improvement with U-turn lanes	
Aime Cesaire intersection improvement	I-03	Underpass	Grade separation
Khar Yalla intersection improvement	I-04a	Flyover	Grade separation
	I-04b	Underpass	
Bourguiba intersection improvement	I-05a	East-west flyover	Grade separation
	I-05b	East-west underpass	
	I-05c	East-south overpass	

Source: JICA Study Team

Proposed Solutions, Costs and EIRRs

Analyses of the technical, demand and economic aspects clarified the solutions presented in Table 7.5 as the most recommendable alternatives. Costs and economic internal rates of return are also presented.

Table 7.5 Proposed Solutions, Costs and EIRR

Intersection	Proposed Solution	Cost (FCFA million)	Economic Internal Rate of Return (%)*
SDE	At-grade improvement	1,230	90.6
Cite Keur Gorgi	Grade separation by flyover in the middle of VDN	14,881	21.6
Aime Cesar	Grade separation by underpass	28,805	19.6
Khar Yalla	Grade separation by flyover	12,715	18.1
Bourguiba	Grade separation by flyover in east-south direction	13,990	17.4
Total		71,621	

Note: *An economic internal rate of return is the discount rate at which the present values of costs and benefits are equal. It is used as an indicator to measure the economic viability of projects. It is generally accepted that the threshold level is 12 %, beyond which a project is judged as economically feasible.

Source: JICA Study Team

Construction Methods and Implementation Schedule

All the five intersections are located along the major arteries in Dakar with high traffic volumes. The sites of the sub-projects I-03, I-04 and I-05 are located in narrow urban areas, where there are buildings, such as houses, shops, a hospital and a school, located close to the road. Thus, securing detour land and construction space is generally difficult. Moreover, the traffic will be closed during the construction period. In consideration of these factors, the preferable construction method should possess the following characteristics: (i) suppression of noise, (ii) suppression of vibration, (iii) shortening of the construction period and (iv) a reduction of space.

For these reasons, the following new construction techniques are proposed and reflected in the cost estimates.

- Steel pipe pile press
- Steel pipe sheet pile press
- Panel bridge
- H-shaped steel bridge
- Steel rectangular slab bridge

Based on the assumption that implementing the proposed projects is to be supported by international cooperation, an implementation schedule assumes a preparation period of two and a half years for preparatory study, loan arrangements, a detailed design process and tender campaign, and a construction period of three years. The completion of the proposed projects is, therefore, planned for the end of 2021.

Environmental Consideration

An environmental analysis conducted at the scoping level clarified that there are no major negative impacts on the environment. It proposes, however, that there is a number of mitigation measures that can be implemented in order to minimize the impacts during the construction period, in terms of air quality, water quality, waste management, soil, noise and vibration.

Priority of Sub-Projects

A multi-criteria analysis conducted for the Study clarified the priorities of each sub-project. The factors analyzed include necessity (speed, congestion, degree of saturation), effectiveness (traffic volume, EIRR, construction costs) and construction conditions (construction period, noise and vibration, resettlement, aesthetic feature, maintenance). The following results were obtained:

- First priority: SDE intersection (88 points out of a total of 120 points)
- Second priority: Cite Keur Gorgui (68 points)/ Aime Cesaire (68 points)
- Third priority: Bourguiba (66 points)
- Fourth priority: Khar Yalla (48 points)

Conclusion and Recommendations

Improvement to the SDE intersection on VDN (I-01e) was found to carry the highest priority. This sub-project is proposed to be implemented by the Senegalese government in consideration of its lower investment cost. It is proposed that the other four sub-projects be promoted to the next stage of preparation, on the assumption that international cooperation is in place with regard to the higher investments costs needed.

7.3 Traffic Improvement Project around Baux Maraichers Bus Terminal

Locations

Figure 7.3 shows the locations of the sub-projects.



Source: JICA Study Team

Figure 7.3 Map of Baw Maraichers Bus Terminal and its Surroundings

Traffic Volumes and Issues

Table 7.6 below presents traffic volume at the N-1/access road intersection and the Rufisque road/access road intersection, as clarified by a series of traffic related surveys. It indicates a high volume of traffic at both intersections.

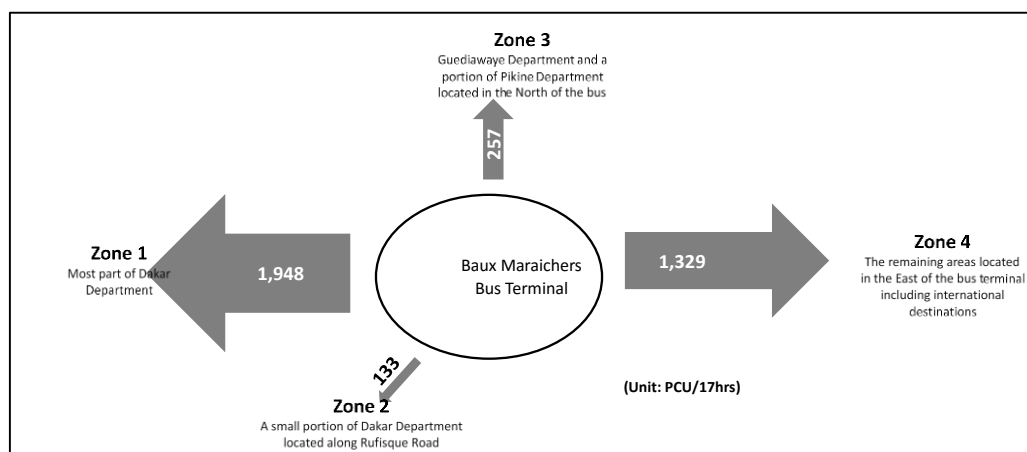
Table 7.6 Traffic Volume at Sub-Project Locations

Code	Location	Traffic Volume (PCU/16hrs)				Total	Flyover/ Underpass Direction
		From north	From south	From east	From west		
I-06	Intersection of NR1	6,760	5,548	18,169	11,921	42,398	East to west
I-07	Intersection of Rufisque Road	6,037	-	8,913	7,955	22,905	-

Note: Shaded cells indicate main traffic directions for which flyovers/underpasses are proposed as improvement alternatives.

Source: JICA Study Team

By grouping the vehicles' destinations into four (4) large zones, Figure 7.4 indicates that vehicles leaving the bus terminal are mainly eastbound or northbound, respectively constituting 53 % and 36 % of the vehicles.



Source: JICA Study Team

Figure 7.4 Distribution by Destination of Vehicles Leaving the Bus Terminal

Alternative Solutions

A set of alternative solutions that would resolve the traffic congestion is established for further analyses, such as grade separation by flyover and by underpass, at-grade improvements, access road widening, establishment of a bus stop at the PTB station, and building an on-ramp and an off-ramp to and from the motorway, as shown in Table 7.7.

Table 7.7 Proposed Alternatives for Improvements

Alternatives/Sub-Projects		
I-06a	A flyover at the intersection of NR1	Intersection of NR1
I-06b	An underpass at the intersection of NR1	
I-06c	Installation of traffic signals at the intersection of NR1	
I-07(1)	Improvement at the intersection of Rufisque Road	Intersection of Rufisque Rd.
I-07(2)	Improvement of access through PTB station entrance	Along Rufisque Road near the PTB station
I-08a	Widening of the access road to four lanes (reconstruction of the bridge)	Access road
I-08b	Widening of the access road to four lanes (both sides of the bridge)	
I-08c	Widening of the access road to four lanes (one side of the bridge)	
I-08d	One-way traffic control on the access road	
I-09(1)a	Direct motorway on-ramp from the terminal (option 1 – north)	Direct motorway ramps
I-09(1)b	Direct motorway on-ramp from the terminal (option 2 – south)	
I-09(2)	Direct motorway off-ramp to the terminal	

Source: JICA Study Team

Proposed Solutions, Costs and EIRRs

Analyses of the technical, demand and economic aspects clarified the solutions presented in Table 7.8 as the most recommendable alternatives. Costs and economic internal rates of return are also presented.

Table 7.8 Proposed Solutions, Costs and EIRR

Code	Proposed Solution	Cost (FCFA Million)	Economic Internal Rate of Return (%)*
I-06a	East-west flyover along N-1	10,141	17.4
I-07(1)	At-grade improvement	371	49.9
I-07(2)	Establishment of bus stop at the PTB station	295	34.2
I-08c	Expansion of the access road from two to four lanes and the bridge to be expanded on one side	4,586	26.3
I-09(1) a	Construction of an on-ramp to the motorway from the northern part of Baux Maraichers Bus terminal	361	42.7
I-09(2)	Construction of an off-ramp to the motorway from the Baux Maraichers bus terminal	14,061	Negative
Total		29,815	

Source: JICA Study Team

Construction Methods and Implementation Schedule

In addition to the five new construction methods, a large block erection method by large crane is proposed. Its advantages include minimization of the closure time of the existing expressway and a shorter construction period.

Based on the assumption that implementing the proposed projects is to be supported by international cooperation, an implementation schedule assumes a preparation period of two and a half years for preparatory study, loan arrangements, a detailed design process and tender campaign, and a construction period of three years. The completion of the proposed projects is, therefore, planned for the end of 2021.

Environmental Consideration

An environmental analysis conducted at the scoping level clarified that there are no major negative impacts on environment. It proposes, however, a number of mitigation measures that would minimize the impacts during the construction period, in terms of air quality, water quality, waste management, soil, noise and vibration.

Priority of Sub-Projects

A multi-criteria analysis conducted as part of the Study clarified the priorities of each sub-project. The factors analyzed include necessity (speed, congestion, degree of saturation), effectiveness (traffic volume, EIRR, construction costs) and construction conditions (construction period, noise and vibration, resettlement, aesthetic feature, maintenance). The following results were obtained:

- First priority: N-1/access road intersection improvement (92 points out of a maximum of 120 points)
- Second priority: Direct motorway on-ramp from the terminal (86 points)
- Third priority: Improvement at the intersection of Rufisque Road (73 points)
- Fourth priority: Widening of the access road to four lanes (65 points)
- Fifth priority: Improvement of access through the PTB station entrance (63 points)

Sixth priority: Direct motorway off-ramp to the terminal (58 point)

Conclusion and Recommendations

The improvement of the N-1/access road intersection is judged as having the highest priority. A multiplier effect could be expected if this component is combined with the sub-project of widening the access road to four lanes, which was the fifth priority. As the investment costs of these two sub-projects are higher, support in the form of international cooperation would be desirable. Since the investment costs of three of the sub-projects (i.e., the Rufisque Road intersection improvement, improvement access to the Baux Maraichers bus terminal for buses and on-ramp construction to ensure direct access to the motorway for buses) are lower, they could be financed by the Senegalese government. An option would be to combine these three sub-projects with the N-1/access road intersection improvements and the access road widening into a single package as the means to upgrade the function of the Baux Maraichers bus terminal in an integrated manner.

The off-ramp construction sub-project is not recommended since its economic return is negative, meaning the costs exceed the benefits even without discounting future values to present values.

7.4 Comparative Analysis of Solid Waste Disposal System Focusing on Waste-to-Energy System

Background

In the Study Area, several issues on solid waste management have been revealed, which correspond to the rapidly increasing urban population and amount of waste. Since there have been no sanitary landfills until now, the current disposal sites are operated in an open-dumping way, causing serious social and environmental problems. The limitation of available lands is another issue on which to focus. It is not easy to identify a proper landfill site, as highlighted by the strong opposition by the public happened against the Sindia landfill operation. Even if the operation of Sindia landfill recommences, the lifespan of the Sindia landfill is only estimated to be 15 years. These challenges point to a stronger demand for proper waste management, such as sanitary treatment and waste reduction in the Study Area. In this context, the JICA Study Team analyzed various options for a solid waste management system with a main focus on the potential of a “waste-to-energy” system as one of the solutions.

Advantages of Waste to Energy System

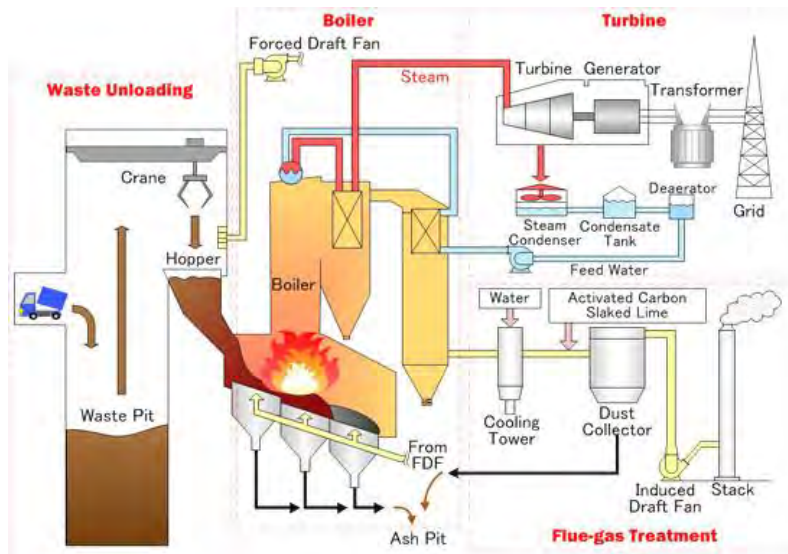
The waste-to-energy, or incineration, system has been widely adopted as an intermediate treatment, prior to final disposal. The main advantages of incineration are listed as follows:

- Final disposal can be conducted in a more sanitary way.
- Significant reduction of waste volume can be attained. The lifespan of landfill sites can be prolonged significantly because the waste can be reduced to 10% in weight and approximately 5 % in volume by incineration.

Under the process of incineration, flue gas with a large amount of thermal energy is produced. The waste-to-energy system is a method of producing electricity (and available heat) for the livelihood of municipal residents by efficient recovery of the generated thermal energy in the gas produced in incineration plants. Power generation would contribute to a reduction in fuel imports and CO₂ generation.

Waste-to-Energy System

A typical system in a waste-to-energy plant is shown in Figure 7.5.



Source: www.yokogawa.com

Figure 7.5 Typical System in a Waste-to-Energy Plant

- The incoming waste is stored temporarily in a waste pit of the incineration plant.
- Using a grab bucket, the waste is thrown into the stoker (furnace) of a boiler to incinerate through a hopper at the appropriate time interval, which is required for continuous and stable incineration.
- In order to effectively incinerate the waste containing a lot of moisture, unique technologies are employed in the design of the stoker. Each incineration plant manufacturer has developed its own technology.
- The flue gas with high temperature heats up water tube lattices at an upper part of a boiler to generate hot steam.
- The high-pressure steam produced is supplied to a steam turbine in a generator room to generate electricity.
- The steam is condensed by an air-cooled stem condenser and is supplied to the boiler cyclically.
- The flue gas from the boiler is decontaminated or cleaned by a series of gas processing units, such as a dust collector, and is released from a stack.

Conclusion and Recommendation

The comparison of waste management systems in the Study Area is summarized in Table 7.9. As a sanitary landfill option, the waste-to-energy system can be considered as the best method for solving existing issues concerning waste management in the Study Area.

It was also found that the waste-to-energy system has advantages from an environmental perspective. While the system may be an expensive option, estimates showed that the large amount of revenue from the sales of electricity could compensate for it. The power sales revenue could be sufficient to recover the construction costs in three to 24 years. In addition, the maintenance cost of the landfills would be saved due to the reduction in the amount of waste to be landfilled.

On the other hand, there are some challenges to be tackled, because the waste-to-energy system is a new technology, not only for Senegal, but also for all Sub-Saharan countries. It is recommended that

based on the results of this analysis, a feasibility study on the Waste to Energy System be conducted with the collaboration of a plant manufacturer. A possibility of introducing the waste-to-energy system to West Africa where neighboring countries are facing the similar problem could be studied as well. Observation tours in developed countries could be arranged as a part of this proposed study to develop understanding of the relevant Senegalese organizations.

Table 7.9 Comparison of Waste Management Systems in the Study Area

No.	Item	1. Current System (Mbuebuess Landfill)	2. Sanitary Landfill System	3. Waste-to-Energy System (Plus Sanitary Landfill)
(1)	Pollution control/sanitary treatment	<i>(Baseline)</i> • Significant environmental impacts are observed	• The environmental impacts can be mitigated	• The risk of pollution by the plants would be limited under a proper treatment system
(2)	Final disposal amount	<i>(Baseline)</i>	• The same as the baseline	• Final disposal amount is reduced by 74 % (volume-based) and 57 % (weight-based)
(3)	Greenhouse gas reduction (CO ₂ emission)	<i>(Baseline)</i> • A large amount of CH ₄ is emitted	• The amount of greenhouse gas is reduced by 50%	• The amount of greenhouse gas is reduced by 85 %
(4)	Investment efficiency	<i>(Baseline)</i> • There is no need for investment	• Investment to construct a new landfill will become necessary in 15 years	• The construction cost will be recovered by sales of electricity, even though the construction costs of incineration plants are relatively high • Urgent construction of additional landfills is not necessary • Power generation can supplement coal-fired power generation, contributing a reduction in coal imports
(5)	Necessity of waste segregation	<i>(Baseline)</i>	• The same as the baseline	• The segregation of combustible waste is required
(6)	Operation and maintenance	<i>(Baseline)</i>	• Some technical workers are needed	• Highly-skilled workers are essential
(7)	Other aspects	• Strong opposition from residents has occurred previously	• Agreement with the residents is necessary	• Agreement with residents is necessary • The coordination with related stakeholders is indispensable (areas of waste management, finance, electricity etc.).

Source: JICA Study Team

CHAPTER 8 URBAN PLANNING MANAGEMENT

8.1 Problem Analysis for Urban Planning Management

As a means to clarify the problems in the existing urban planning management system, a “problem analysis” was conducted in April 2015 in the form of a workshop by the JICA Study Team and the DUA counterpart team. The core problem was assumed to be that “the existing 2025 Master Plan is not effective enough”, which is taken as a hypothesis in the present study. As a result of the workshop and subsequent analysis by the JICA Study Team experts, a problem tree was constructed, as shown in Figure 8.1. This problem tree identifies six factors that may cause the core problems.

Factor-1: Urbanization has not followed the land use plan. This is more a phenomenon explaining the core problem than its cause. Three boxes below Factor-1 in Figure 8.1 specify the situation. An urbanization pattern inconsistent with the land use plan is observed in such forms as spontaneous urban development in undesirable areas, the numerous structures built without compliance to the land use plan and the implementation of subdivision projects in unsuitable areas.

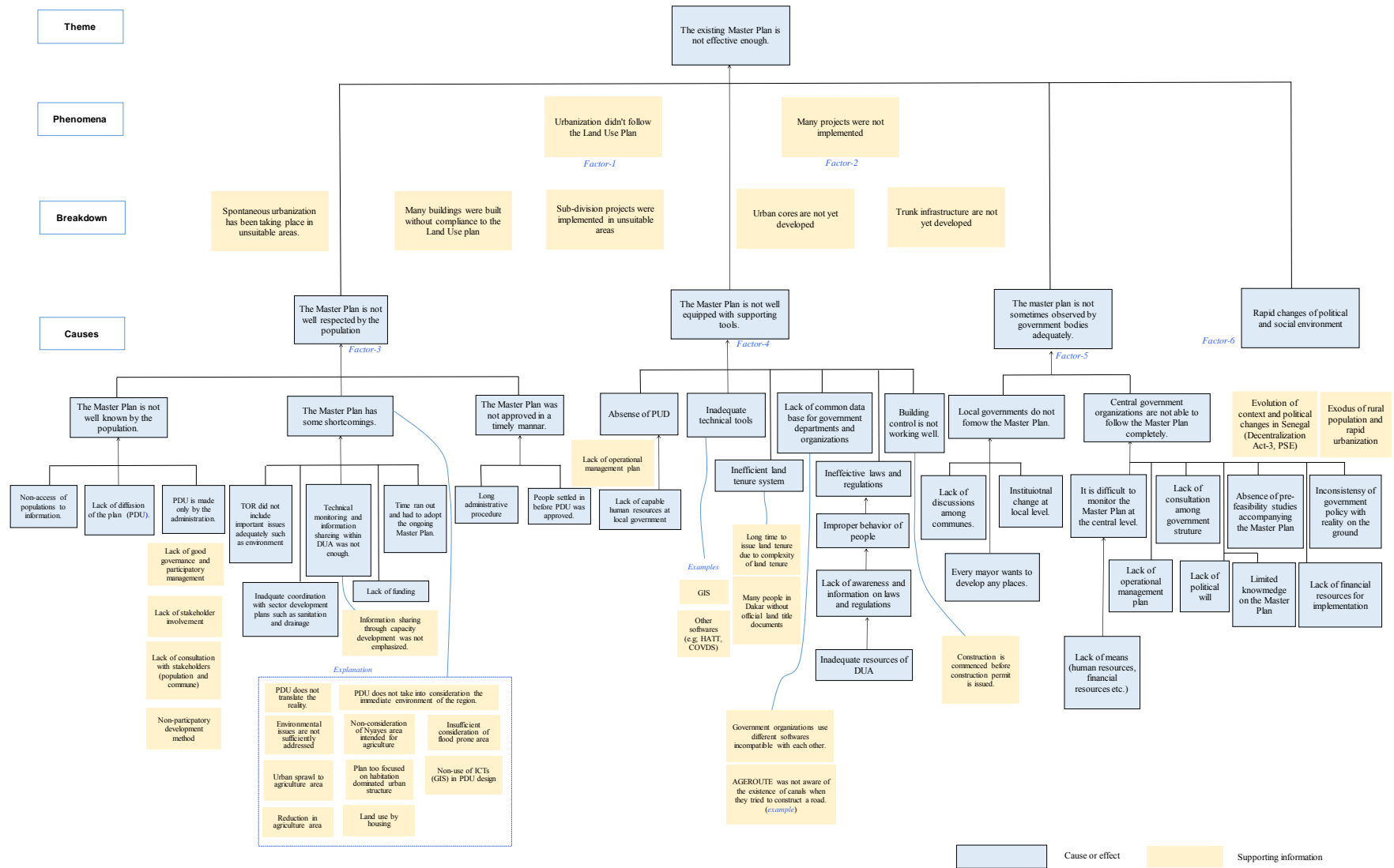
Factor-2: Many projects have not been implemented. This is also a phenomenon explaining the core problem. The two boxes below Factor-2 in Figure 8.1 specify the situation. Non-implementation of projects is observed in such issues as non-development of urban cores and non-development of trunk infrastructures.

Factor-3: The Master Plan is not well respected by the people. This is a factor causing urbanization that is inconsistent with the Master Plan. Three factors are listed as reasons that explain why the Master Plan is not well respected by the people: (i) it is not well known by the people, (ii) it has some shortcomings, and (iii) it was not prepared in a timely manner.

Factor-4: The Master Plan is not well equipped with supporting tools. This is another factor causing urbanization that is inconsistent with the Master Plan. The supporting factors include the absence of a PUD, inadequate technical tools, an inefficient land tenure system, a lack of common database and ineffective laws and regulations.

Factor-5: The Master Plan is sometimes not adequately observed by government bodies.

Factor-6: Rapid changes in the political and social environment.



Sources: DUA and JICA Study Team

Figure 8.1 Problem Analysis of Urban Planning Management

8.2 Policy Directions to Improve the Urban Management System

8.2.1 Policy directions to improve the urban management system

The policy directions to improve the existing urban management plan are identified in such a way as to address the three causal factors in the tentative problem tree (i.e., Factor-3, Factor-4 and Factor-5) and to consider basic issues underlying all these issues. The effectiveness of the present 2035 Master Plan, which revises the 2025 Master Plan, will be enhanced once measures are taken concerning the directions given below.

Direction 1: Enhancing People's Recognition of the Master Plan (Corresponding to Factor-3)

Expected Condition: The Master Plan is Known Well by the Population and the Private Sector

- Promotion of a participatory planning approach to reflect the views of stakeholders in the Master Plan
- Dissemination of information about the Master Plan as well as the introduction of development controls relating to the people and the private sector by various means
- Improved accessibility to the information about the Master Plan

Expected Condition: The Master Plan is Prepared Properly

- Enhanced capacity of the officials in charge
- Improvements to the information database for a land use map, which includes land use, building size, building structure, built year etc.

Expected Condition: The Master Plan is Prepared Timeously

- Securing an annual budget to prepare the Master Plan in a timely manner
- Allocation of an annual budget for the detailed urban plan for local governments

Direction 2: Enhancing the Supporting Tools for the Master Plan (Corresponding to Factor-4)

Expected Condition: Land Administration is Working Well

- Reinforcement of the hierarchy of urban plans and urban development projects
- Encouragement of the population to obtain plots in suitable areas through extending the grace period for tax exemption
- Strengthening of the formalization of the land tenure system by shortening and simplifying the land registration process

Expected Condition: Building Control is Working Well

- Enhanced monitoring of the misuse of land and illegal construction
- Enhanced capacity in building permission management
- Enhanced capacity in land development permission management
- Increased penalties for illegal constructions

Direction 3: Enhancing Recognition of the Master Plan in Central Government Organizations and Local Government (Corresponding to Factor-5)

Expected Condition: Local Government Follows the Master Plan

- Enhanced involvement of local government to prepare the Master Plan and the detailed urban plan
- Reinforcement of the hierarchy of urban plans and urban development projects as specified in the means for Direction 2
- Enhanced ownership by the population of the Master Plan

Expected Condition: Ministries and Agencies Follow the Master Plan

- Strengthening of the authority of DUA in enforcing the master plans and revitalization of regional and national planning commissions.
- Enhanced cooperation between related central government ministries, departments and organizations by information dissemination and sharing. Relevant ministries and agencies will update sector master plans in compliance with the 2035 Master Plan.
- Authentication of the Master Plan including introducing legislation for a UGB and the issuance of a Presidential Decree with regulations to enforce the Master Plan (the procedure for the authentication will be completed in due time soon after the preparation of the 2035 Master Plan)
- Assignment of an organization to be exclusively responsible for the development and management of urban poles that stretch across more than one administrative unit

8.2.2 Basic issues underlying overall urban development management

There are a number of challenges to be addressed, which underline all the issues mentioned above. They are summarized as follows:

- Enhanced technical capability of DUA planners through periodic training, technical guidance and the application of planning guidelines
- Strengthening of the role of *villes* in supporting *communes* in the surrounding areas in the planning and service provision through the DUA's technical assistance mechanism
- Gradually shift in the DUA's focus towards urban policy formulation, the establishment of standards and regulations, and institutional support in parallel with the devolution of responsibilities to local government

8.3 Capacity Development Plan of the DUA

Objective and Strategies

The objective of capacity development is to establish a system and support the strengthening of human capacities by which desirable urban spaces will be created in the context of the Decentralization Act III. The following are the strategies for capacity development:

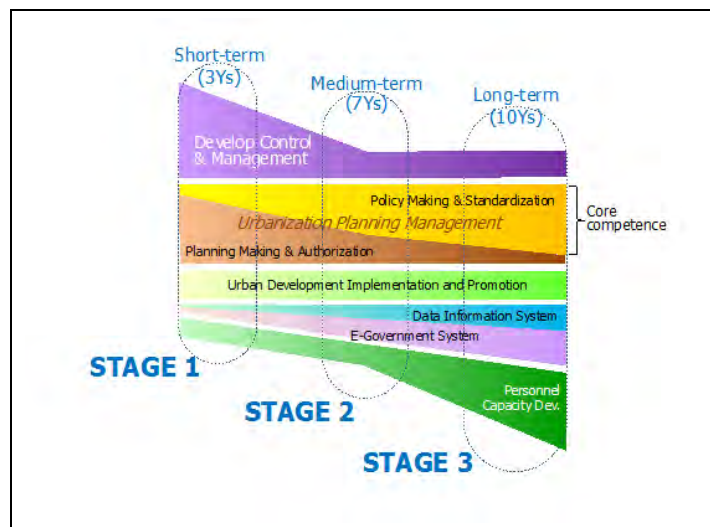
- Strategy 1: To clarify the ultimate roles and functions of the relevant organizations, such as the DUA, local government and the private sector, in urban planning preparation and management in 2035 and identify transitional steps in order to reach this ultimate stage
- Strategy 2: To strengthen the institutional and organizational capacities of the relevant organizations

Strategy 3: To strengthen the individual technical and managerial capacities of the officers of the relevant organizations to support the expected roles and functions of each organization

Transformation of the DUA’s Role

The DUA’s role and functions will be gradually shifted from direct involvement in planning preparation, management and development control towards policy and strategy preparation and support of local governments, as presented in Figure 8.2. The following are some of the important points in this transformation process:

- Urban planning and management will always be the core competence with different focuses depending on the situation on each occasion.
- Planning works related to implementation, such as the Cooperative Development Zones (ZAC), Urban Renewal (RU), Land Consolidation (RE), and Restructuring (R), will remain the task of the DUA until 2035, while those related to the PDU and the PUD will be devolved to local government.
- A part of the DUA’s control and permit works will be devolved to local government, except for large scale or multi-jurisdictional cases as well as the planning and introduction of innovative control measures.
- The DUA will play a positive role in establishing an efficient information management system within its own organization and with relevant government organizations to share and exchange information externally.
- The ultimate role of the DUA in individual capacity development will be to support local governments in expanding their technical base.



Source: JICA Study Team

Figure 8.2 Conceptual Diagram for the DUA’s Organizational Development Roadmap

Strengthening the Capacities of the DUA and Local Governments

The following are the measures to systematically strengthen the organizational capacity of the DUA:

Short-term (2016-2018): Development of the medium stratum of staff, preparation of job descriptions, creation of a system to support self-learning, securing a budget for scholarships, development of the curriculum on urban planning in cooperation with educational institutions, and making the internship system a more strategic one.

Medium-term (2019-2025): Promotion of an inter-organizational personnel transfer mechanism, formulation of specialist groups, such as a GIS section, and an increase in staff with a permanent status.

Long-term (2026-2035): Establishment of an urban planning training center and the establishment of a professional certification system.

The individual capacities of DUA officers will be strengthened first in the short-term by creating an internal training system, which capitalizes on the knowledge and experiences of senior and retired DUA officers. In the medium-term, the DUA will begin to apply its know-how in upgrading the capacities of its staff to meet the capacity development of local government. In the long-run, an urban planning training center will be created where DUA staff, local government staff and those from other organizations will be able to receive training in urban planning systematically.

CHAPTER 9 ACTION PLAN FOR THE DUA

9.1 Investment Requirement-Fund Availability Balance

The requirement for public funds to realizing the 2035 Master Plan on an annual basis is estimated to account for 13 % of the 2015 budget for capital expenditure, as show in Table 9.1. This level of requirement for public funds is broadly judged to be within an affordable range of the government’s capital expenditure budget. For private investment, the Senegalese government needs to ensure the conditions of investment required by the private sector are appropriately balanced with serving the public interest.

Table 9.1 Balance of Funding Requirement for the 2035 Master Plan and Budget Availability

Item	Amount
a. Budget for capital expenditure by government in 2015	FCFA 962.186 billion
b. Total requirement of public investment for 2035 2035 Master Plan (Table 4.10)	FCFA 2.555,476 trillion
c. Annual average requirement of public investment for 2035 Master Plan (b./20 years)	FCFA 127.774 billion
d. Proportion of public investment for 2035 Master Plan to capital expenditure (c/a)	13 %

Source: JICA Study Team

9.2 Policy Packages

All the plans and concepts proposed are packaged into eight policy packages containing 22 components and 70 actions. It is recommended that relevant organizations and ministries align the actions under each policy package in their own development plans and programs and take actions toward implementation.

9.3 Action Plan for the DUA

The Study recommends that the DUA takes a number of actions to materialize the proposals of the Study as follows:

Formalization Process of the Master Plan and the Daga Kholpa Detailed Plan

The DUA will take necessary actions for the approval process, including the following events:

- Preparation of regulatory conditions for the Master Plan and the detailed plan
- Approval by the stakeholders including *communes* and regional committees
- Approval of the SEA report by the DEEC
- Approval and proclamation of the PDU by the President
- Transmission of the approved PDU to the national archives for security purposes

The DUA is subsequently recommended to move on to the next stage of disseminating the Master Plan and the detailed plan to all the stakeholders by undertaking the following activities:

- Preparation and printing of the documents summarizing the 2035 Master Plan and the detailed urban plan for distribution
- Preparation and printing of explanatory documents for distribution

- Holding seminars and workshops to present and distribute the documents to central government ministries and organizations, local government and the private sector
- Supporting central government ministries and organizations and local government in aligning their policies and plans with the framework of the 2035 Master Plan and the Daga Kholpa detailed plan

Pre-feasibility Study

The DUA is recommended to take the following actions:

- To communicate with relevant ministries and organizations in charge of transportation and solid waste management, such as the AGEROUTE, the CETUD, the Ministry of Environment and the CADAK-CAR, and reach an agreement on promoting the projects to the next stage
- To secure funds for the next stage of studies
- To support the undertaking of feasibility studies for transportation projects in taking required procedures
- To support the undertaking of a detailed study on the waste-to-energy project in consideration of the important factors that would affect the viability of the project, such as the price of electricity and the interest of private producers in incineration and power generation plants

Capacity Development at Institutional, Organizational and Individual levels

The DUA is recommended to take action to develop technical and managerial skills among its officers according to the proposed capacity development plan as a short-term priority.

Promotion of the 2035 Master Plan Policy Package

The DUA will propose to the government for creating a platform for implementing the 2035 Master Plan Policy Package. The DUA could function as the secretariat for this platform. The platform will be the forum in which to promote cooperation and coordination of the activities by different ministries, organizations and local governments within the framework of the 2035 Master Plan Policy Package, paying due attention to enhancing sustainability.