JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

GOVERNMENT OF SOUTHERN SUDAN

JUBA URBAN TRANSPORT INFRASTRUCTURE AND CAPACITY DEVELOPMENT STUDY IN THE SOUTHERN SUDAN

FINAL REPORT (1)

PART I GENERAL

PART II URBAN TRANSPORT DEVELOPMENT MASTER PLAN

JULY 2010

CTI ENGINEERING INTERNATIONAL CO., LTD.
YACHIYO ENGINEERING CO., LTD.

PREFACE

In response to the request from the Government of Southern Sudan (GOSS), the Government of Japan decided to conduct the "Juba Urban Transport Infrastructure and Capacity Development Study" and entrusted the Study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched the Study Team headed by Mr. Tsuneo Bekki of CTI Engineering International Co., Ltd. in association with Yachiyo Engineering Co., Ltd. from August 2008 to June 2010.

The Study Team held discussions with the officials of the Ministry of Transport and Roads, the Land Commission and other concerned agencies of GOSS as well as the Ministry of Physical Infrastructure of Central Equatoria State (CES), and conducted field surveys, data gathering and analysis, formulation of the Master Plan and Pre-Feasibility Study. In addition, the stakeholders' meetings were conducted nine times in total to solicit opinions from various actors concerning the Study. Upon returning to Japan, the team prepared this Final Report to summarize the results of the Study.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Southern Sudan and the Central Equatoria State for their close cooperation and help extended to this Study.

July 2010

Kiyohumi KONISHI
Director General
Economic Infrastructure Department
Japan International Cooperation Agency

Mr. Kiyohumi KONISHI
Director General
Economic Infrastructure Department
Japan International Cooperation Agency

Dear Sir,

LETTER OF TRANSMITTAL

We are pleased to submit herewith the Final Report of the "Juba Urban Transport Infrastructure and Capacity Development Study" in Juba urban area in Southern Sudan. The report includes the advice and suggestions of the authorities concerned of the Government of Japan and your Agency, as well as the comments made by the Ministry of Transport and Roads and other concerned agencies of the Government of Southern Sudan (GOSS) and the Ministry of Physical Infrastructure of the Central Equatoria State (CES).

This report analyses the present setting and future conditions and demand of urban transport infrastructure in Juba urban area. It comprehensively covers the issues of transport including road development and policy, urban street improvement, public transport, traffic management, urban street maintenance system, capacity development throughout the pilot project, road institution and urban environment. The report established a Road Network Master Plan for Juba and surrounding areas until the year 2025 and the Capacity Development Plan for the Ministry of Physical Infrastructure of CES. The outcome of the Study concludes that the established plans are technically, economically, environmentally and socially feasible and will contribute to the development of Juba urban area.

In view of urgency of the development of transport infrastructure in Juba urban area and the needs for socio-economic development of Southern Sudan, we recommend that the GOSS implements the projects with utmost urgency.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs and the Ministry of Land, Infrastructure and Transport in the Government of Japan. Further, we wish to express our deep gratitude to the Ministry of Transport and Roads and other agencies concerned in the GOSS, and the Ministry of Physical Infrastructure of CES for their close cooperation and assistance extended to us during the course of the Study.

Very truly yours,

Tsuneo BEKKI
Team Leader
Juba Urban Transport Infrastructure
and Capacity Development Study

LOCATION MAP

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ACRONYMS AND ABBREVIATIONS

AADT	:	Annual Average Daily Traffic
AASHTO	:	American Association of State Highway and Transportation Officials
AC	:	Asphalt Concrete
AIDS	:	Acquired Immunodeficiency Syndrome
ASTM	:	American Society for Testing and Materials
B/C	:	Benefit/Cost Ratio
BCRP	:	Bridges and Culverts Reconstruction Project
CAI	:	Clean Air Initiative
CBD	:	Central Business District
CBR	:	California Bearing Ratio
CCD	:	Central Commercial District
CCG	:	Community Construction Group
C/D	:	Capacity Development
CES	:	Central Equatoria State
CPA	:	Comprehensive Peace Agreement
DBST	:	Double Bituminous Surface Treatment
DEM	:	Digital Elevation Model
DMR	:	Department of Road Maintenance
EB	:	Equipment Based
EIA	:	Environmental Impact Assessment
EIRR	:	Economic Internal Rate of Return
ERRP	:	Emergency Road Rehabilitation Project
ESAL	:	Equivalent Single Axle Load
GDP	:	Gross Domestic Product
GIS	:	Geographic Information System
GNI	:	Gross National Income
GOJ	:	Government of Japan
GONU	:	Government of National Unity
GOSS	:	Government of Southern Sudan
GRDP	:	Gross Regional Domestic Product
HCM	:	Highway Capacity Manual
HIV	:	Human Immunodeficiency Virus
HR	:	Human Resources

ICAO	:	International Civil Aviation Organization
IDA	:	International Development Association
IDP	:	Internally Displaced Person
IEE	:	Initial Environmental Examination
IMCT	:	Inter-Ministry Committee for Transport
IOM	:	International Organization for Migration
I/S	:	Intersection
JAM	:	Joint Assessment Mission
JICA	:	Japan International Cooperation Agency
JRA	:	Japan Road Association
LB	:	Labor Based
LOS	:	Level of Service
MAD	:	Mean Absolute Difference
MBA	:	Maintenance by Administration
MBC	:	Maintenance by Contract
MDTF	:	Multi Donor Trust Fund
M&E	:	Monitoring and Evaluation
MEWCT	:	Ministry of Environment, Wildlife, Conservation and Tourism
MFEHR	:	Ministry of Finance, Economy and Human Resources
MFEP	:	Ministry of Finance and Economic Planning
MHPPE	:	Ministry of Housing, Physical Planning and Environment
MHLPU	:	Ministry of Housing, Land and Public Utilities
MOH	:	Ministry of Health
MOPI	:	Ministry of Physical Infrastructure
MSL	:	Mean Sea Level
MTR	:	Ministry of Transport and Roads
MWRI	:	Ministry of Water Resources and Irrigation
NGO	:	Non-Governmental Organization
NMIMT	:	Non-Motorized and Intermediate Means of Transport
NMT	:	Non-Motorized Transport
NPV	:	Net Present Value
NSCSE	:	New Sudan Centre for Statistics and Evaluation
OD	:	Origin-Destination
OJT	:	On-the-Job Training
PCM	:	Project Cycle Management
PCP	:	Physically Challenged People

PCU	:	Passenger Car Unit
PDM	:	Project Design Matrix
PM	:	Periodic Maintenance
PMT	:	Project Management Team
P/P	:	Pilot Project
PSI	:	Present Serviceability Index
QCBS	:	Quality- and Cost-Based Selection
R/A	:	Roundabout
RCPC	:	Reinforced Concrete Pipe Culvert
RM	:	Routine Maintenance
ROW	:	Right of Way
RR	:	Road Rehabilitation
RTC	:	River Transport Corporation
RTSMU	:	Road Traffic and Safety Management Unit
SARPS	:	Standards and Recommendation Practices
SDG	:	Sudani Pounds (Monetary Unit)
SETIDP	:	Sudan Emergency Transport and Infrastructure Development Project
SN	:	Structural Number
SNAP	:	Sudanese National AIDS Control Programme
SOSUS	:	Southern Sudan SPLM Areas
SPLA	:	Sudan Peoples Liberation Army
SPLM	:	Sudan Peoples Liberation Movement
SRA	:	State Road Agency
SSAC	:	Southern Sudan AIDS Commission
SSCCSE	:	Southern Sudan Commission for Census, Statistics and Evaluation
SSCRA	:	Southern Sudan County Road Agency
SSEC	:	Southern Sudan Electricity Corporation
SSRA	:	Southern Sudan Road Agency
SSRB	:	Southern Sudan Road Board
SSURA	:	Southern Sudan Urban Road Agency
SSUWC	:	Southern Sudan Urban Water Corporation
STD	:	Sexually Transmitted Disease
TA	:	Technical Assistance
TAST	:	Technical Assistance Team
TNA	:	Training Needs Analysis
TRL	:	Transport Research Laboratory
UN	:	United Nations
UNDP	:	United Nations Development Program

UNICEF	:	United Nations International Children's Fund
UNOPS	:	United Nations Office for Project Services
USAID	:	United States Agency for International Development
USD	:	US Dollar
USGS	:	United States Geological Survey
UTM	:	Universal Transverse Mercator
VCR (V/C)	:	Volume-Capacity Ratio
WB	:	World Bank
WFP	:	World Food Programme
WG	:	Working Group
WGS	:	World Geodetic System

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Part I

General

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 BACKGROUND

Urban infrastructure such as roads, water supply system, etc. in Southern Sudan, even in the capital Juba is not well provided due to civil wars lasting for more than 20 years. Under such situation, the Japan International Cooperation Agency (JICA) conducted the “Emergency Study on the Planning and Support for Basic Physical and Social Infrastructure in Juba Town and the Surrounding Areas” (the Emergency Study) which was completed on March 2007. The Emergency study included the formulation of an urban infrastructure development plan targeted on year 2015, the identification of urgently needed infrastructure projects and the implementation of three pilot projects, namely, improvement of Juba Port, provision of water supply facilities in Munuki, and establishment of vocational skills training facility.

In the Emergency Study, the progress of refugees and Internally Displaced Persons (IDPs) returning was monitored. However, the returning movement is expected to be accelerated as Juba recovers and its condition improves. At present, Juba has many negative factors for development and investment, such as obscure demarcation of the roles of the Government of the Southern Sudan (GOSS) and the State Government, undefined land tenure, etc. However, even with such negative factors, rehabilitation of the existing infrastructures is being undertaken initiated by GOSS while private investments started to pour in. It is expected that in the future, the population growth in Juba will be accelerated further and the urbanized area will be expanded.

Under such situation, serious urban problems are expected to arise - such as shortage in capacity of basic infrastructure like roads and water supply, disorderly land use due to development without guidance, spread of residential areas in poor environment conditions like slums, difficulty in providing job opportunities for people without experience to be engaged in urban industries including refugees and IDP returnees. These expected problems need preventive measures, one of which GOSS considered in urgent need is the improvement of the urban transport network, especially the improvement of the urban roads including secondary arterial roads with a total length of some 85km. A part of the road improvement being implemented is the on-going “Emergency Road Rehabilitation Project” which covers a total length of 63km and the proposed reconstruction of bridges and culverts as a separate project.

With such background, the GOSS requested a technical cooperation from the Government of Japan (GOJ) to conduct the “Juba Urban Transport Infrastructure and Capacity Development Study” (the Study) based on the findings of the Emergency Study. In response to the request, GOJ has decided to conduct the Study and JICA, the official agency responsible for the implementation of the technical cooperation program of GOJ, has organized and dispatched a Study Team for the Study to be conducted in accordance with the Scope of Work agreed between GOSS and JICA in February 2008.

1.2 OBJECTIVES OF THE STUDY

The objectives of the Study are as follows:

(1) To formulate a transport network master plan for Juba Town and its surrounding areas with the target year until 2025, based on the review of the transport development plan in the Emergency Study,
(2) To formulate a project for the reconstruction of bridges/culverts which is not included in the on-going "Emergency Road Rehabilitation Project",
(3) To conduct feasibility studies on high priority projects in the transport network master plan,
(4) To prepare a capacity development plan for the engineers in-charge of the road improvement and maintenance in the Ministry of Transport and Roads (MTR) of GOSS, the Ministry of Physical Infrastructure (MOPI) of Central Equatoria State (CES) and other organizations related to the Study, and to support in the execution of the capacity development plan, and
(5) To support in planning and implementation of pilot projects as an important part of the capacity development.

1.3 STUDY AREA

The Study shall cover Juba Town and the surrounding areas (Juba urban area).

1.4 SCOPE OF THE STUDY

In order to achieve the objectives mentioned above, the Study shall cover the following items:

TASK **01**: Preparation of Inception Report
TASK **02**: Presentation and Discussion of Inception Report
TASK **03**: Review and Analysis of the Present Condition of the Study Area
TASK **04**: Site Survey of the Study Area
TASK **05**: Traffic Survey
TASK **06**: Formulation of Transport Network Development Master Plan
- (1) Establishment of socio-economic framework
- (2) Traffic demand forecast
- (3) Establishment of transport network development strategies and policies
- (4) Establishment of design standards
- (5) Formulation of transport network development master plan

TASK **07**: Formation of Bridges/Culvers Reconstruction Project
- (1) Selection of target bridges/culverts
- (2) Natural condition survey
- (3) Establishment of design policy
- (4) Preliminary plan and design
- (5) Construction plan
- (6) Project cost estimate
- (7) Project justification

(8) Preparation of project report

TASK **08**: Preparation of Capacity Development Plan for MTR and MOPI

(1) Review of road improvement/maintenance system of MTR and MOPI

(2) Identification of problems in MTR and MOPI's systems

(3) Preparation of capacity development plan

TASK **09**: Preparation and Discussion of Progress Report

TASK **10**: Support in Execution of Capacity Development Plan through Pilot Project (First Phase)

(1) Support in creation of working group for pilot project

(2) Support of working group in preparation of pilot project plan

(3) Procurement of computers, printers/copiers and application software for mapping necessary for road inventory survey, preparation of data base and formulation of maintenance plan

TASK **11**: Feasibility Study of High Priority Projects (First Phase)

(1) Selection of projects for feasibility study

(2) Preparatory works

TASK **12**: Preparation and Discussion of Interim Report

TASK **13**: Amendment of master plan based on census results

TASK **14**: Support in Execution of Capacity Development Plan through Pilot Project (Second Phase)

(1) Support in pilot project implementation

(2) Evaluation of pilot project implementation

TASK **15**: Feasibility Study of High Priority Projects (Second Phase)

(1) Formulation of urban street maintenance system

(2) Urban street improvement in Central Commercial District (CCD)

(3) Route location study of major arterials

(4) Urban street network development in southern Juba

TASK **16**: Conclusion of Study and Recommendations

TASK **17**: Preparation and Discussion of Draft Final Report

TASK **18**: Counterpart Training

TASK **19**: Support in Execution of Capacity Development Plan through Pilot Project-2

(1) Support in creation of working group for pilot project-2

(2) Support of working group in preparation of plan of pilot project-2

(3) Establishment of implementation system

(4) Support in implementation of pilot project-2

(5) Evaluation of implementation of pilot project-2

TASK **20**: Preparation and Discussion of Draft Supplemental Report

TASK **21**: Preparation of Final Report

The study flow of the whole work is illustrated schematically in Figure 1.4-1.

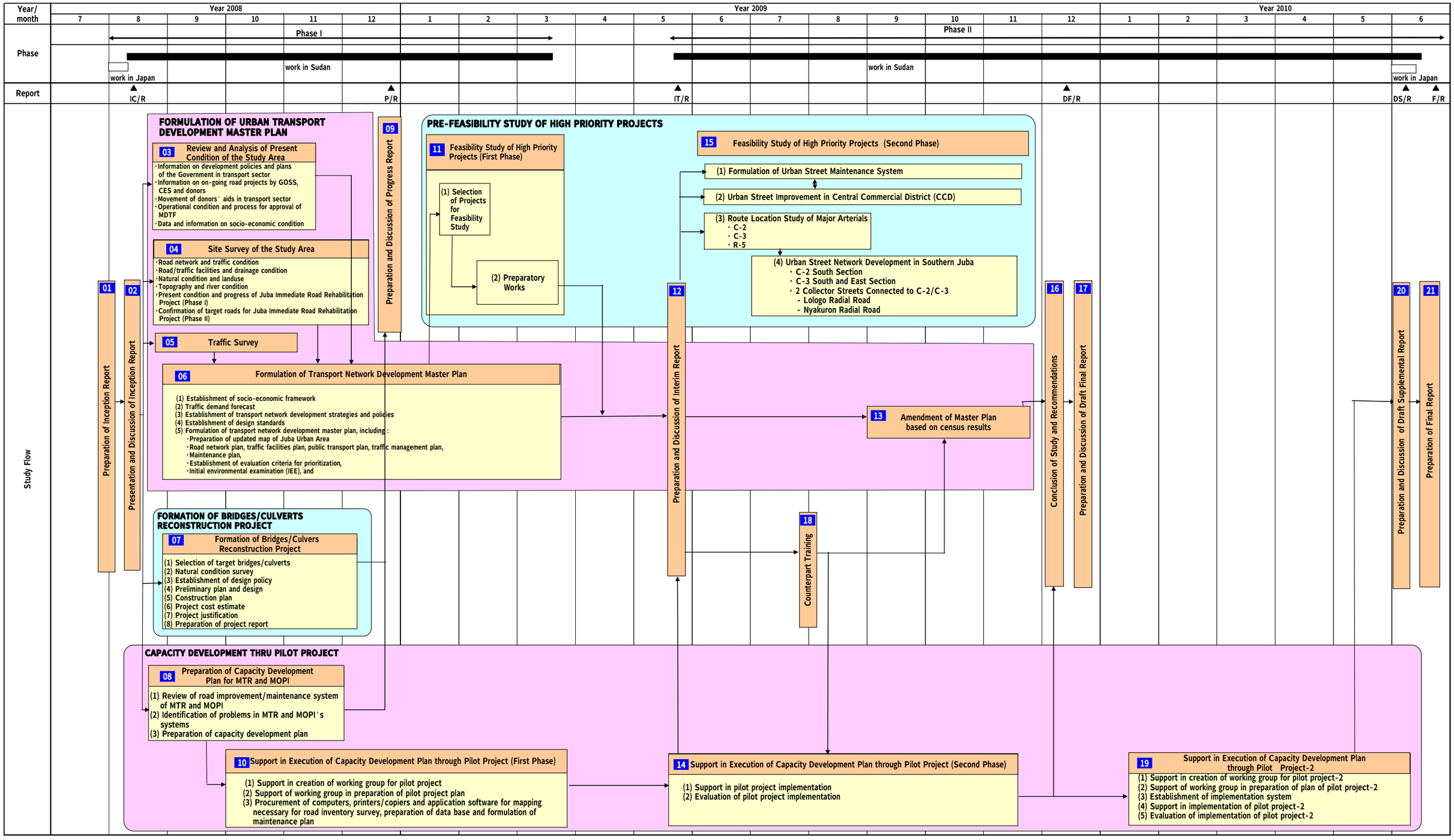
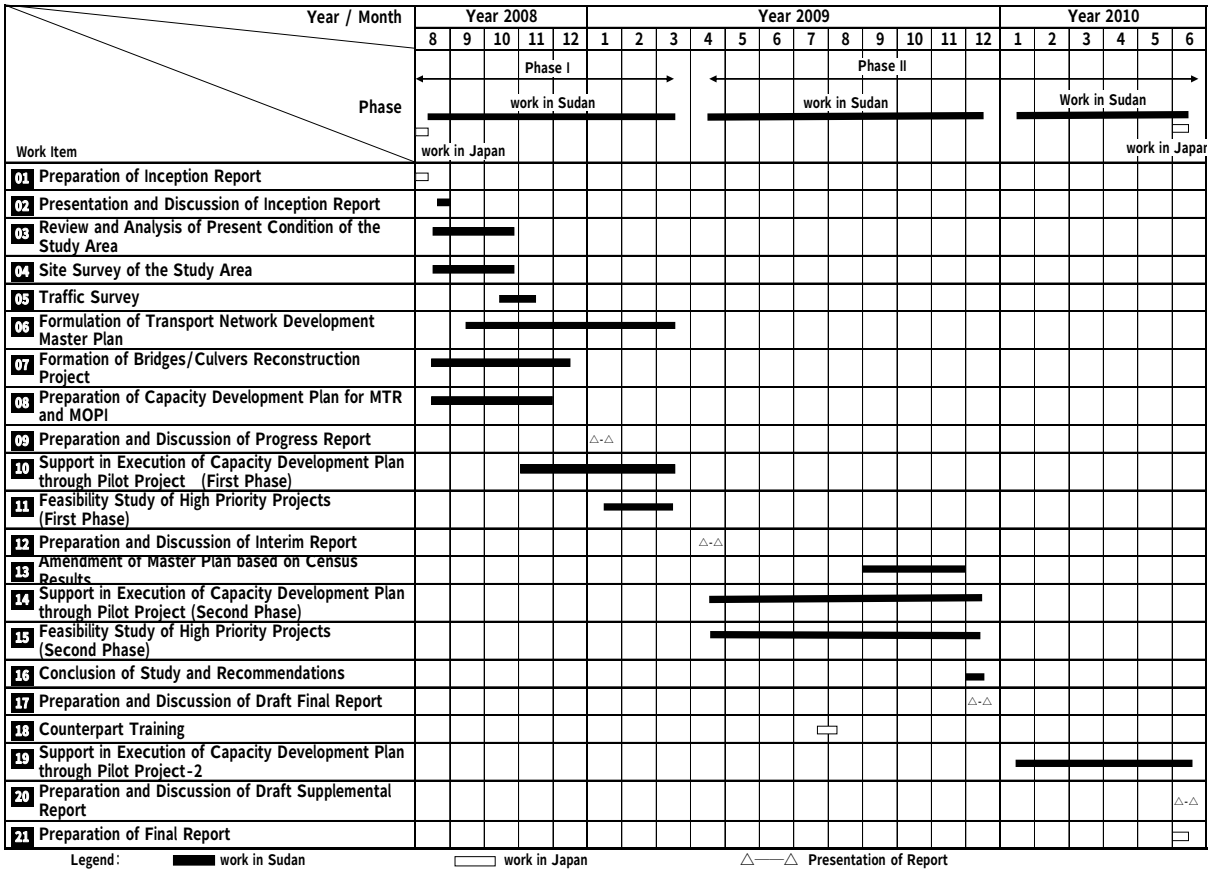


Figure 1.4-1 Study Flow Diagram

1.5 STUDY SCHEDULE AND PROGRESS

The Study commenced in August 2008 and completed in June 2010. Table 1.5-1 presents the study schedule.

Table 1.5-1 Study Schedule and Progress



1.6 STAKEHOLDERS MEETING

During the Study, a series of the Stakeholders Meetings were held to discuss the issues and concerns of the stakeholders and to reflect the discussed matters in the Study. The date and agenda are as follows:

	Date	Agenda
・1st Meeting:	28 Aug. 2008	- Inception Report presentation
・2nd Meeting:	5 Nov. 2008	- Future land use
		- Road network plan
		- Bridge and culvert reconstruction plan
・3rd Meeting:	16 Feb. 2009	- Urban transport development policy and strategy
		- Road network development plan
		- Implementation plan
		- Pilot project plan
		- Proposed projects for feasibility study
・4th Meeting:	2 Jun. 2009	- Interim Report presentation

・5th Meeting:	1 Jul. 2009	- Proposed road network for Juba and surrounding areas - Alternative routes for major arterials (C-2, C-3 and R-5)
・6th Meeting:	18 Aug. 2009	- Environmental and social considerations
・7th Meeting:	30 Oct. 2009	- Execution and evaluation of pilot project - Capacity development plan
・8th Meeting:	15 Dec. 2009	- Draft Final Report presentation
・9th Meeting:	3 Jun. 2010	- 2nd Pilot Project Presentation/Workshop - Evaluation of 2nd Pilot Project

The program, presentation materials, minutes of meeting and list of attendant of the Stakeholders Meetings are presented in Appendices 1 to 9.

1.7 ORGANIZATION OF THE STUDY

The Study is carried out by the Study Team organized and managed by JICA with the cooperation of GOSS and the Government of Central Equatoria State. The members involved in the Study are as follows:

JICA

Mr. Yuichi Sugano	Director, Urban and Regional Development Division II, Urban and Regional Development Group, Economic Infrastructure Department, JICA
Mr. Naomichi Murooka *	Senior Program Officer, Urban and Regional Development Division II, Urban and Regional Development Group, Economic Infrastructure Department, JICA
Mr. Shigehiko Sugita **	Urban and Regional Development Division II, Urban and Regional Development Group, Economic Infrastructure Department, JICA
Mr. Kenichi Shishido	Resident Representative, JICA Sudan Office
Mr. Kensuke Oshima	Project Formulation Advisor, JICA Sudan Office
Mr. Kiyotaka Tamari	Project Formulation Advisor, JICA Sudan Office

Government of Southern Sudan

H.E. David Deng Athorbei *	Minister, MTR
H.E. Anthony Lino Makana **	Minister, MTR
Dr. Daniel Wani *	Undersecretary, MTR
Eng. Raymond Pitia Morbe **	Undersecretary, MTR
Mr. Jacob Marial Maker	Director General, Roads & Bridges, MTR
Mr. Gabriel Makur Amour	Director, Roads & Bridges, MTR
Mr. Lado T. Tombe	Director, Road Transport & Safety, MTR
Mr. Otim Bong Mike	Deputy Director, Urban Roads, Roads & Bridges, MTR
Mr. Philip Waiwai	Deputy Director, Road Maintenance and Equipment, Roads & Bridges, MTR
Mr. James Alam	Project Manager, Interstate Roads, Roads & Bridges, MTR
Mr. Duku George Aggrey	Project Manager, Bridges, Roads & Bridges MTR

Government of Central Equatoria State

H.E. Prof. Ladu Bureng	Minister, MOPI
Mr. Lewis Gore George Modi	1st Director General, MOPI
Mr. Peter Laku Loro Ladu	Director General, Roads & Bridges, MOPI
Mr. Emmanuel Matayo Wani	Director General, Housing & Construction, MOPI
Mr. Bullen Pitya Abraham	Deputy Director, Roads & Bridges, MOPI
Mr.Charles Hakim Mila	Deputy Director for Planning

Study Team

Mr. Tsuneo Bekki	Team Leader / Transport Planner
Mr. Kunihiko Sawano *	Deputy Team Leader / Highway Planner
Dr. Shingo Gose **	Deputy Team Leader / Highway Planner
Mr. Ryuichi Ueno	Highway Designer
Mr. Shrestha Robinson	Highway Designer
Mr. Mitsuo Kiuchi	Bridge Planner / Designer
Dr. Jovito C. Santos	Bridge Designer / Project Planner
Mr. Takeshi Yoshida	Capacity Development Specialist
Mr. Yasuhiro Yamauchi	Project Coordinator
Mr. Toyohiro Takagi	Project Coordinator
Mr. Ryuichi Yamasaki	Construction Planner / Cost Estimator
Mr. Yuzi Sorayama	Natural Condition Surveyor
Mr. Mamoru Shibata	Environmental and Social Considerations Specialist
Ms. Madoka Aizawa	Highway Location Planner
Mr. Yozo Mizota	Highway Maintenance Specialist

* Predecessor

** Successor

CHAPTER 2

PRESENT CONDITION OF THE STUDY AREA

CHAPTER 2 PRESENT CONDITION OF THE STUDY AREA

2.1 ADMINISTRATIVE SYSTEM

2.1.1 Administrative Division of Southern Sudan

The administrative divisions of Southern Sudan consist of the State – County – Payam – Boma structure as shown in Figure 2.1.1-1. Southern Sudan is divided into 10 states; Central Equatoria State is composed of 6 Counties; and Juba County is composed of 16 Payams and 89 Bomas. Figure 2.1.1-2 illustrates the boundaries of the administrative divisions of the States and the Payams of Juba County.

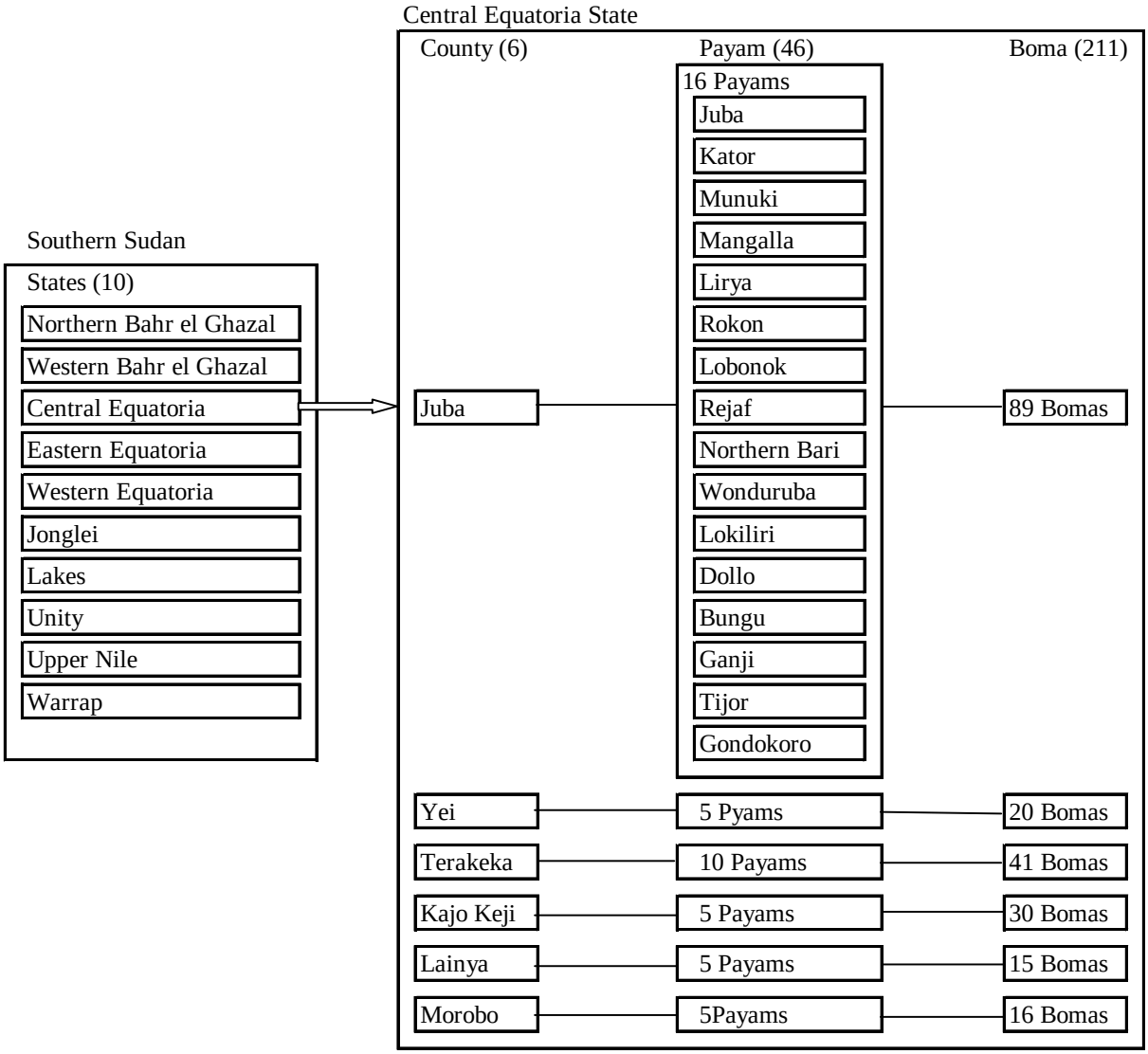
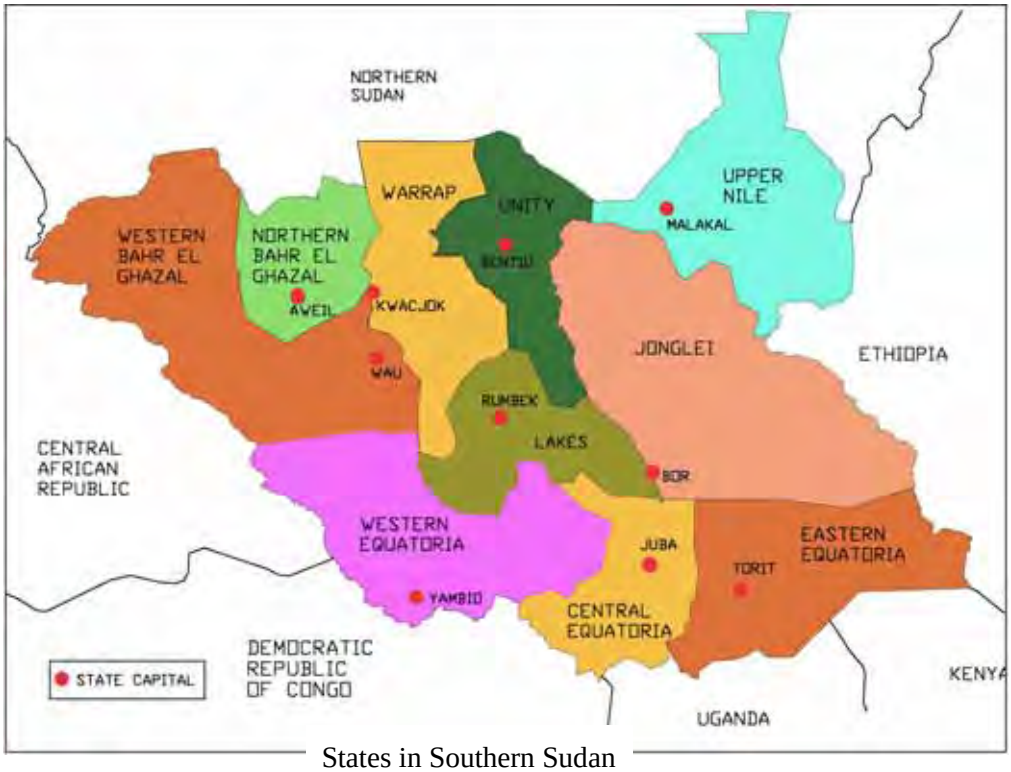
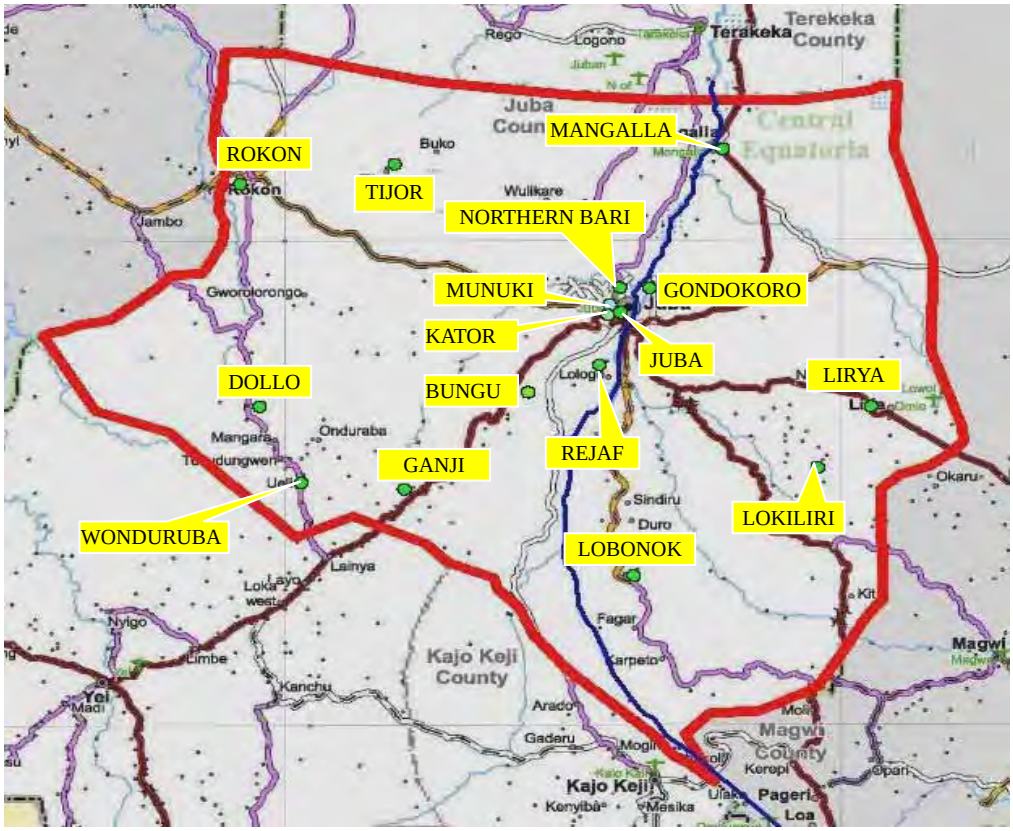


Figure 2.1.1-1 Administrative Structure of Southern Sudan



States in Southern Sudan



Payams in Juba County

Figure 2.1.1-2 Administrative Divisions

The present Juba Urban area is composed of 3 Payams of Juba, Kator and Munuki, and its surrounding areas include Payams of Northern Bari and Rejaf.

2.1.2 Organization of GOSS and CES

The Government of the Southern Sudan (GOSS) is administered by 23 Ministries under the President and Vice President. Independent from the Ministries, there are established 12 Commissions, 3 Chambers, a Fund, 2 Authorities, an Assembly, a Board, a Judiciary and 2 Corporations. The organization of GOSS is shown in Figure 2.1.2-1.

The Government of Central Equatoria State is headed by the Governor and administered by 6 Ministries, as shown in Figure 2.1.2-2.

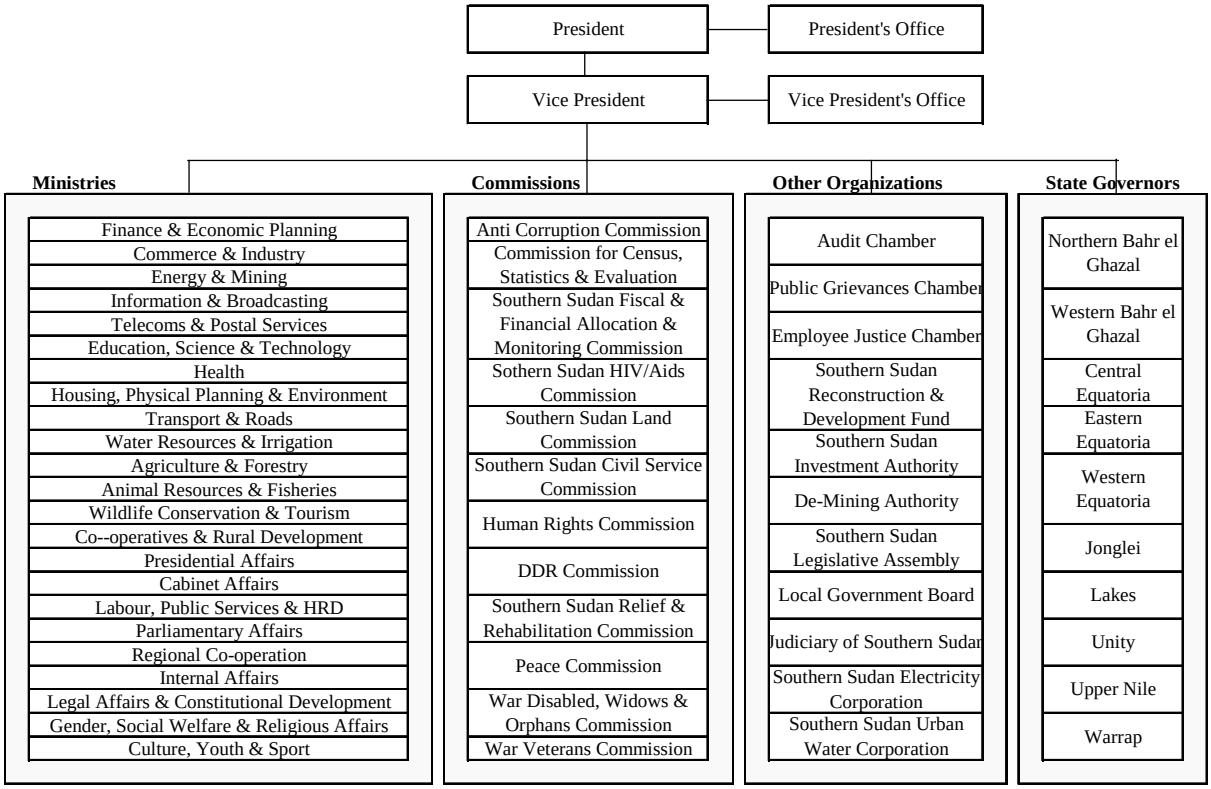


Figure 2.1.2-1 Organization of the Government of the Southern Sudan

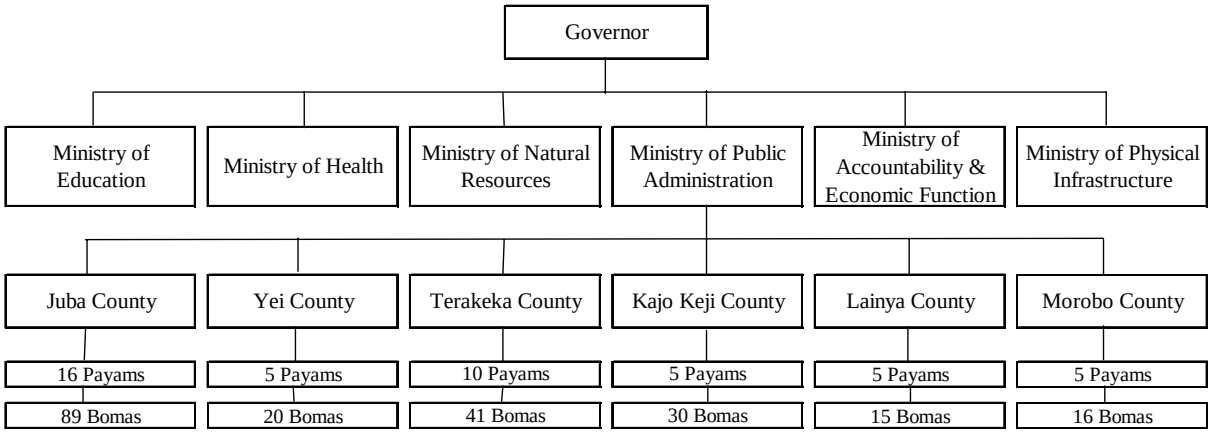


Figure 2.1.2-2 Organization of Central Equatoria State

2.2 NATURAL CONDITION

2.2.1 Location

Juba Town is located at 4°52′ north of the equator and 31°36′ east of eastern longitude, at an altitude of 460m above sea level.

2.2.2 Climate

In general, the temperature is high throughout the year with distinct characteristics of the dry and rainy seasons.

The monthly average minimum temperatures based on the 1998 to 2004 statistics (excluding 2001) fall in the range of 19.4°and 23.7° whereas the monthly average maximum temperatures for the same period were between 31.5° and 37.9°. The lowest monthly average minimum temperature was mostly recorded in December, while the highest average maximum temperature predominantly occurred either in January or February.

The rainy season usually starts in May and lasts to October. The average annual precipitation level is around 1,000mm. However, occasionally, precipitation levels of more than 1,200mm may be recorded. Most rainfall during the year concentrates in the rainy season, with almost no rainfall observed in the dry season (Table 2.2.2-1 and Figure 2.2.2-1)

The prevailing winds are always from the south. Nevertheless, in January and February winds mostly prevail from the north-north-west direction.

Table 2.2.2-1 Monthly Rainfall in JUBA

Month	1998	1999	2000	2002	2003	2004	Average
Jan.	10.4	0	0	0	4	14.3	3.6
Feb.	0	0.5	0	1.5	30	1.2	0.8
Mar.		32.2	48	91.5	66.1	36.5	50.2
Apr.	76.6	320.3	4.8	87.6	71	122.2	89.4
May.	64.1	100.7	62.5	43.2	218	74.8	75.5
Jun.	178.3	188	154.9	206.7	91.2	153.5	168.7
Jul.	146.8	106.8	136.9	148.6	148.9	115.1	136.9
Aug.	55.4	149.3	68.5	127.5	197.4	305.2	135.7
Sep.	42.7	142.4	90.9	175.6	149.6	56.5	109.9
Oct.	328.2	205.3	194.4	209.9	50.1	92.8	175.6
Nov.	45.4	29.2	24.3	48	206.9	97.3	55
Dec.	0	0	0	34.2	12.2	0.5	3.2

Note: Average = average of 4 years excluding minimum and maximum value.

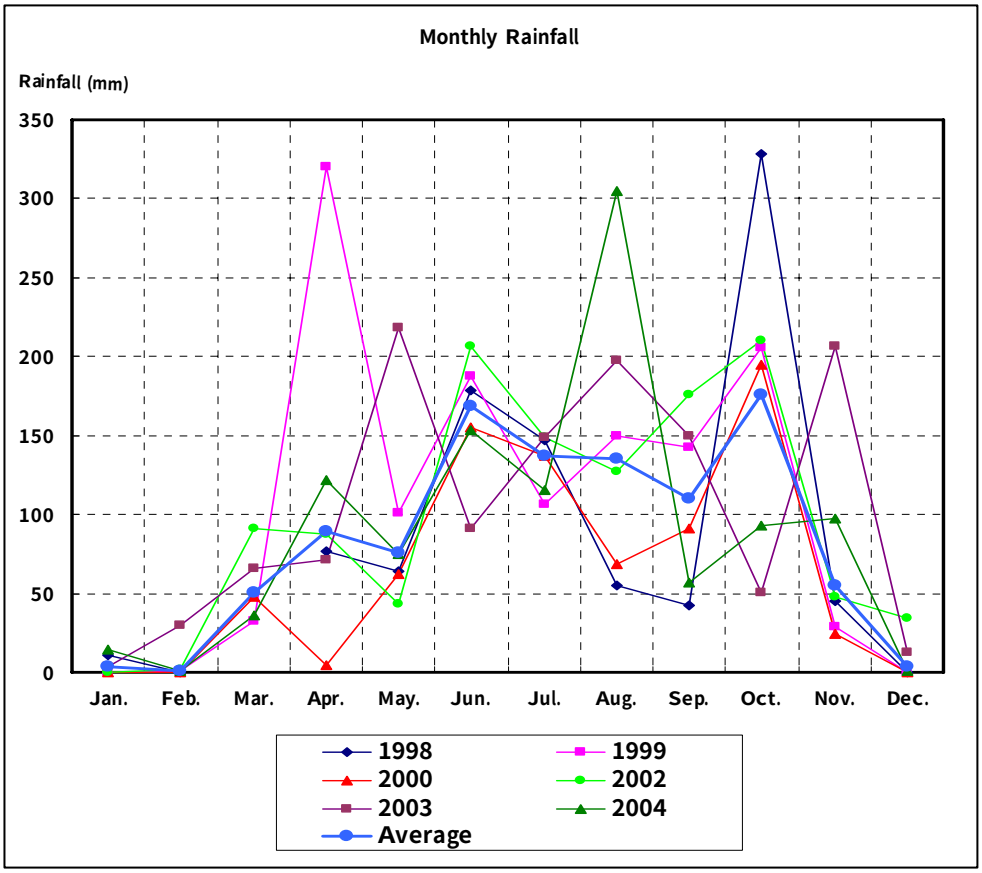


Figure 2.2.2-1 Monthly Rainfall in JUBA

2.2.3 Topography

Juba Town and the surrounding area are located in the large Bahr al Jebel alluvial plain which inclines from south-southwest to north-northeast direction in general.

The White Nile River, with an average width between 250m to 600m width, delineates the town boundary in the east.

A gentle slope generally characterizes the area, where outcrops of hard and firm crystalline rocks are found. Among these outcrops of rocks, the most outstanding one is Jebel Krok, with an altitude of 744m above Mean Sea Level (MSL), 3km width and 1km length, located to the west of Juba Town and forming the natural boundary of the Juba Town area.

In the rainy season, the flooding water affects an area covering almost 50% of the alluvial plain prompting the emergence of the temporal and seasonal rivers flowing into the White Nile River.

2.2.4 Seismic Intensity

The record of the seismograph around Juba is shown following Table 2.2.4-1, the oldest record is 1982 years and the largest scale occurred in May 20, 1990.

Number of recorded seismic activity is few. If the earthquake on May 24, 1990 with magnitude of M=7.1 occurring four days after the large-scale earthquake is an aftershock, the number of large scale earthquake is very few.

Table 2.2.4-1 Seismic Intensity List

No.	Magnitude	Date	Original Time	Depth of Hypocenter (km)	Distance from JUBA (km)
1	5.0	27-May-1990	7:29:00 AM	10.0	16
2	5.1	15-Oct-1982	8:37:00 AM	10.0	25
3	5.0	26-May-1990	2:22:00 PM	10.0	37
4	5.2	10-Jan-1991	7:06:00 AM	11.4	38
5	5.0	02-Mar-1992	8:30:00 PM	10.0	41
6	6.5	24-May-1990	7:34:00 PM	16.5	54
7	5.0	03-Oct-1992	4:22:00 PM	33.0	57
8	6.6	09-Jul-1990	3:11:00 PM	12.6	61
9	7.1	24-May-1990	8:00:00 PM	16.0	63
10	5.2	20-Jun-1990	6:47:00 PM	15.6	64
11	5.2	07-Sep-1990	12:12:00 AM	10.0	66
12	7.2	20-May-1990	2:22:00 AM	14.9	67
13	5.3	25-May-1990	12:42:00 AM	10.0	69
14	5.5	24-May-1990	10:16:00 PM	10.0	71
15	5.1	03-Jun-1990	4:23:00 PM	10.0	87
16	5.3	28-Jul-1990	4:46:00 PM	10.0	118
17	5.4	29-Mar-1991	9:06:00 AM	10.0	125
18	5.0	11-Dec-1990	5:09:00 AM	10.0	127

Seismic data are based on United States Geological Survey (United States Geological Survey USGS)

The earthquake occurrence position in Juba and the surrounding areas and the earthquake occurrence position in a wide area is shown in Figure 2.2.4-1 and Figure 2.2.4-2.

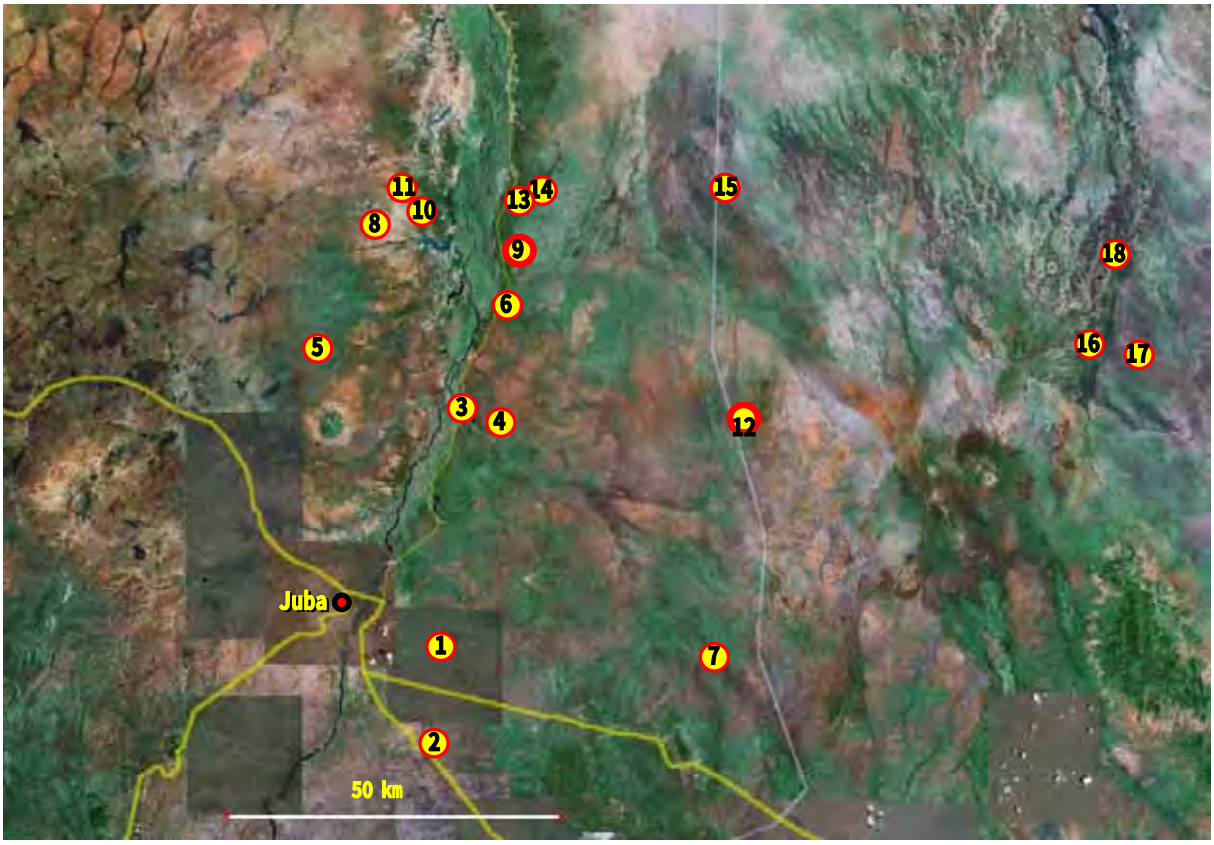


Figure 2.2.4-1 Earthquake Occurrence Position in Juba and Environs

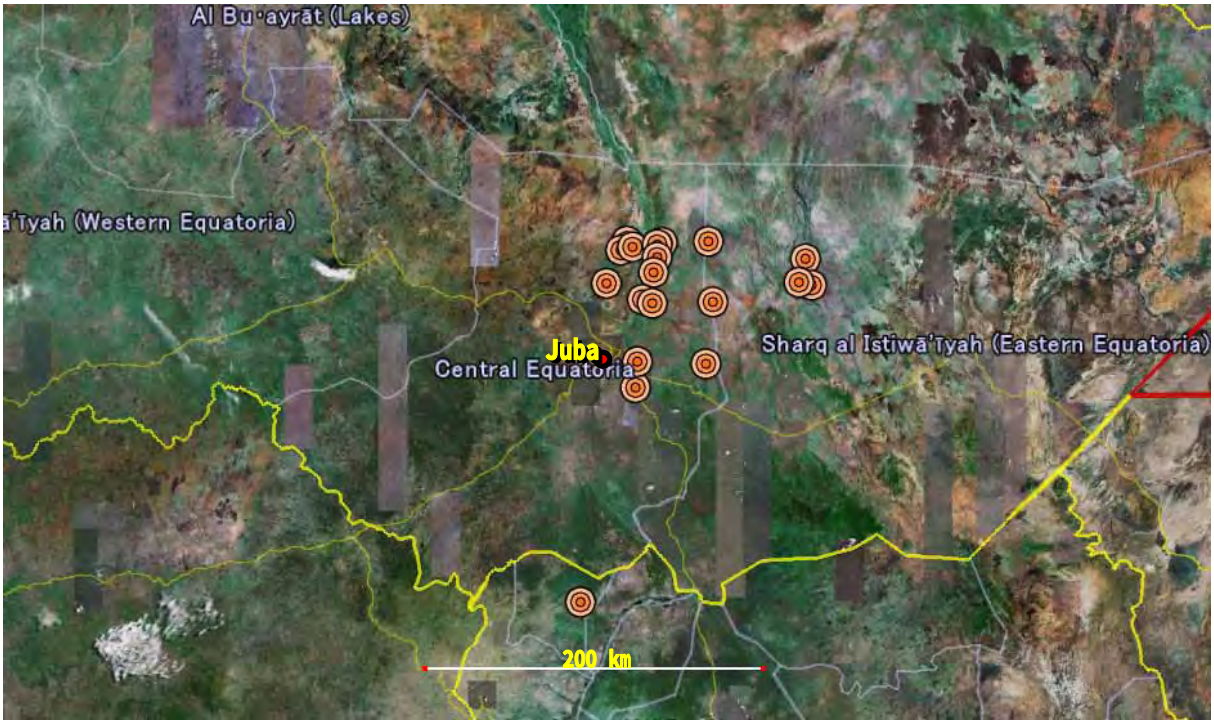


Figure 2.2.4-2 Earthquake Occurrence Position in Juba Wide Area

2.2.5 Land Type

Most of the land around Juba is covered with the bush. The river is of gentle slope with approximately 120km in length and flows to the east from the west at the north 10km of Juba and it is surrounded with the ponds around Juba.

There are many trees in both banks of the white Nile River and its tributaries. Woods and cultivated field also abound in the area.

A large pond and an open ground are on the north side of the airport, and grasslands and cultivated fields spread out in the northeastern direction.

Figure 2.2.5-1 illustrates the basic land types in Juba.

Figure 2.2.5-1 Land Type in Juba

2.3 SOCIO-ECONOMIC CONDITION

2.3.1 Population

(1) Population of Sudan

The population censuses were carried out in 1973, 1983, 1993 and 2008. The 1993 census covered all northern states but the southern states could not be entirely covered due to security considerations. Based on 1993 population for the northern states and 1983 population in the southern states, the populations by the year 2006 were estimated by Central Bureau of Statistics. 1973-2008 population of Sudan is summarized in Table 2.3.1-1 and graphically shown in Figure 2.3.1-1.

Table 2.3.1-1 Population of Sudan for the Years 1973 - 2008

Year	All Sudan	Northern Sudan	Southern Sudan	Source
1973	14,114,000	11,309,000	2,805,000	Census
1983	20,598,000	15,324,000	5,274,000	
1993	25,588,000	21,267,000	4,321,000	
2004	34,512,000	29,146,000	5,366,000	Statistical Year Book for the Year 2006 (Estimated by Central Bureau of Statistics)
2005	35,397,000	29,949,000	5,448,000	
2006	36,297,000	30,767,000	5,530,000	
	37,710,000	n.a.	n.a.	World Bank : World Development Indicators Database, September 2008
2007	38,560,000	n.a.	n.a.	
2008	39,154,490	30,894,000	8,260,490	Census

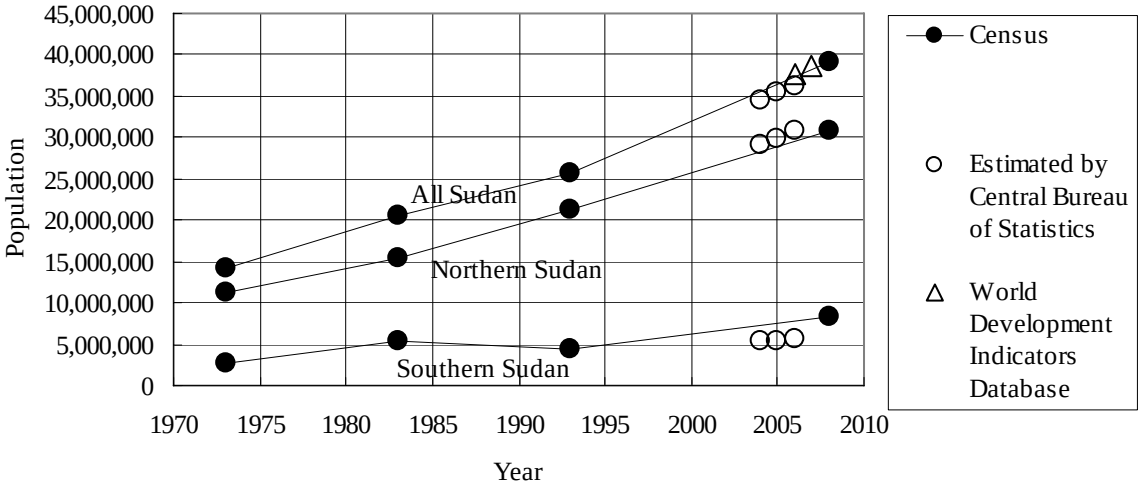


Figure 2.3.1-1 Population of Sudan for the Years 1973 – 2008

Table 2.3.1-2 shows the average annual population growth rate.

Table 2.3.1-2 Average Annual Population Growth Rate

(% p.a.)

Year	All Sudan	Northern Sudan	Southern Sudan
1973 to 1983	3.85	3.08	6.52
1983 to 1993	2.19	3.33	-1.97
1993 to 2008	2.88	2.52	4.41

Influenced by the civil war, the population growth of Southern Sudan changed as follows :

1973 to 1983 : High growth (6.5%)

1983 to 1993 : Negative growth (-2.0%) due to IDPs

1993 to 2008 : High growth (4.4%) due to returnees

Population growth of Southern Sudan from 1983 to 2008 is 1.8% in average, still small comparing with all Sudan, indicating that return of IDPs is not finished yet.

(2) Population of Juba Urban Area

2008 census results are shown in Table 2.3.1-3.

Table 2.3.1-3 2008 Population

Area	Total	Male	Female
All Sudan	**39,154,490**	**20,073,977**	**19,080,513**
Northern Sudan	**30,894,000**	**15,786,677**	**15,107,323**
Southern Sudan	**8,260,490**	**4,287,300**	**3,973,190**
Northern Bahr el Ghazal State	**720,898**	**348,290**	**372,608**
Western Bahr el Ghazal State	**333,431**	**176,895**	**156,536**
Central Equatoria State	**1,103,592**	**581,544**	**522,048**
Juba County	**372,413**	**205,674**	**166,739**
Bungu Payam	2,737	1,429	1,308
Dolo Payam	14,132	7,530	6,602
Ganji Payam	2,689	1,358	1,331
Gondokoro Payam	6,522	3,211	3,311
Juba Payam	82,346	48,854	33,492
Kator Payam	64,130	35,012	29,118
Lirya Payam	5,949	3,008	2,941
Lokiliri Payam	8,215	4,274	3,941
Lobonok Payam	8,980	4,536	4,444
Mangala Payam	11,016	6,036	4,980
Munuki Payam	83,719	45,743	37,976
Northern Bari Payam	39,810	23,088	16,722
Rejaf Payam	15,604	8,274	7,330
Rokon Payam	5,684	2,906	2,778
Tijor Payam	8,132	4,116	4,016
Wonduruba Payam	12,748	6,299	6,449
Yei County	**201,443**	**105,165**	**96,278**
Terakeka County	**140,396**	**71,984**	**68,412**
Kajo Keji County	**196,422**	**98,321**	**98,101**
Lainya County	**89,315**	**47,424**	**41,891**
Morobo County	**103,603**	**52,976**	**50,627**
Eastern Equatoria State	**906,126**	**465,365**	**440,761**
Western Equatoria State	**619,029**	**318,469**	**300,560**
Jonglei State	**1,358,602**	**734,327**	**624,275**
Lakes State	**695,730**	**365,999**	**329,731**
Unity State	**585,801**	**300,247**	**285,554**
Upper Nile State	**964,353**	**525,430**	**438,923**
Warrap State	**972,928**	**470,734**	**502,194**

Source : 2008 Census

Juba urban area includes Juba Payam, Kator Payam, Munuki Payam, Rejaf Payam and a part of Northern Bari Payam. The total population of Juba urban area in 2008 is estimated as shown in Table 2.3.1-4.

Thus, the population of Juba urban area is about 260,000 in 2008, composed of 56% male and 44% female.

Table 2.3.1-4 2008 Population of Juba Urban Area

Area	Total	Male	Female
Juba Payam	82,346	48,854	33,492
Kator Payam	64,130	35,012	29,118
Munuki Payam	83,719	45,743	37,976
Rejaf Payam	15,604	8,274	7,330
Northern Bari Payam (assuming 1/3)	13,270	7,696	5,574
Total	259,069	145,579	113,490
	(about 260,000)	(56%)	(44%)

(3) Return of IDPs and Refugees

The March 2005 report of the Sudan Joint Assessment Mission (JAM) estimated that approximately 4 million people were displaced from (or within) Southern Sudan by the 20 years of fighting between the northern and southern regions of Sudan. Following the signing of the Comprehensive Peace Agreement (CPA) in January 2005, IOM calculates that both the North-South and the South-South return movements up to June 2008 stand at almost 1.8 million.

IOM, in the "IOM Tracking of Spontaneous Returns Project", has been conducting the tracking of a large number of the returnees within a huge geographic area. By extrapolation of the tracking data, the total number of returns that have occurred to South Sudan and Southern Kordofan is estimated. The tracking activities in Sudan are divided into two types : "En-route Tracking" and "Area of Return Tracking". En-route Tracking is the recording of returnee movements by collecting data at main transport routes, transit hubs, key geographic entry points etc., while Area of Return Tracking is the gathering of data on returnee movements by physically visiting villages in the area of return to collect data. The total number of returnees is estimated from the following equation:

$RE=(x \cdot 100) / y$

Where, RE : the estimated number of returnees
x : total number of returnees tracked
y : percentage of villages coverage out of the total village.

The numbers of tracked returnees and estimated total returnees are summarized in Table 2.3.1-5. The total number of returnees to South Sudan and Southern Kordofan is estimated at 1.77 million, out of which the returnees to Central Equatoria State (CES) account for about 10%, amounting to 178,050. The returnees to Juba urban area are not known, but En-route Tracking data shows that the total number of tracked returnees to Juba urban area is 12,413* accounting for 90 % of the total tracked returnees to CES (13,786). Assuming that 90 % of the total returnees to CES are those to Juba urban area, the number of the total returnees to Juba urban area is about 160,000 (=178,050 x 90%).

* 10,185(Juba) + 813(Kator) + 1,415(Munuki) + 90(Rejaf) = 12,413

Table 2.3.1-5 Cumulative Number of Returnees up to June 2008

Final Destination			Tracked Returnees		Projected Number of Returnees up to June 2008, based on Area of Return Tracking Data
State	County	Payam	Area of Return Tracking Data (Feb.2007 - June 2008)	En-route Tracking Data (Nov.2005 - June 2008)	
Central Equatoria	Juba	Juba		10,185	
		Kator		813	
		Munuki		1,415	
		Bungu		8	
		Dolo		8	
		Liria		8	
		Lobonok	1,483	32	
		Mangalla		16	
		Molbor		2	
		Rejaf		90	
		Rokon		22	
		Wonduruba	229	17	
		Total	1,712	12,616	
	Yei River	Lasu	453	46	
		Mugwo	489	1	
		Otogo	861	480	
		Tore	345	11	
		Yei Town	1,222	227	
		Lainya		113	
		Morobo		54	
		Total	3,370	932	
	Terakeka	Terakeka		94	
		Tali		11	
		Tombe		5	
		Total		110	
	Kajo Keji	Kangepo I	211	19	
		Kangepo II	234	18	
		Lire	406	81	
		Livolo	304		
		Ngepo	12	6	
		Total	1,167	124	
	Lainya	Kenyi	3,799		
		Kopera	3,177	2	
		Lainya	715		
		Mukaya	1,175	2	
		Wuji	2690		
		Total	11,556	4	
	Total		17,805	13,786	178,050
Northern Bahr el Ghazal	Total		140,617	43,171	401,763
Western Bahr el Ghazal	Total		34,267	1,099	62,304
Eastern Equatoria	Total		20,824	2,039	53,395
Western Equatoria	Total		14,919	1,495	124,325
Jonglei	Total		5,460	6,474	182,000
Lakes	Total		74,952	6,073	91,405
Unity	Total		26,024	8,837	113,148
Upper Nile	Total		11,488	33,219	143,600
Warab	Total		18,890	22,161	125,933
Southern Kordofan	Total		298,098	68,314	298,098
Total of Southern Sudan and Southern Kordofan State			663,344	206,668	1,774,021

Source : IOM Tracking of Spontaneous Returns Project, Total Returns to South Sudan, Post CPA to June 2008

The population of Juba urban area is estimated to change as follows:

- Until 2005, the population decreased to about 100,000 due to displacement.
- Up to 2008, about 160,000 IDPs returned or migrated to Juba. As a result, the 2008 population reached about 260,000.
- The return movement may still continue after 2008.

2.3.2 Economy

Table 2.3.2-1 shows the gross domestic product (GDP) by sector for the years 2004 – 2006 shown in the Statistical Yearbook.

The GDP growth rate is high, showing 7.4 %, 8.7 % and 9.4 % in 2004, 2005 and 2006 respectively. The GDP per capita grows also at high rates of 4.7 %, 6.0 % and 6.7% in 2004, 2005 and 2006 respectively.

The composition of GDP is as follows:

- Agricultural sector accounts for 34.0 %, 32.6 % and 31.1 % in 2004, 2005 and 2006 respectively, approximately one third, and tends slightly downward.
- Mining/Industrial sector (Petroleum～Building & Construction in Table 2.3.2-1) accounts for 21.4 %, 23.1 % and 25.0 % in 2004, 2005 and 2006 respectively, approximately one fourth, and tends upward due to significant increase of petroleum and considerable increase of building and construction.
- Service sector (Commerce, Restaurant & Hotels and below in Table 2.3.2-1) accounts for 44.6 %, 44.3 % and 43.9 % in 2004, 2005 and 2006 respectively, showing a constant share.

Table 2.3.2-1 Gross Domestic Product at Current Market Prices

Kind of Economic Activity	2004			2005			2006		
	GDP (million SD)	Percentage	Growth Rate* (%)	GDP (million SD)	Percentage	Growth Rate* (%)	GDP (million SD)	Percentage	Growth Rate* (%)
Agriculture, Livestock, Forestry & Fishing	2,336,944.7	34.0	-2.0	2,632,428.0	32.6	2.8	2,965,272.1	31.1	3.5
Petroleum	476,074.0	6.9	17.1	672,002.2	8.3	9.5	948,564.7	10.0	37.9
Mining and Quarrying	12,009.0	0.2	-17.0	15,184.2	0.2	15.0	19,198.8	0.2	16.0
Manufacturing and Handicrafts	639,250.0	9.3	6.0	754,621.7	9.3	9.5	890,815.8	9.3	8.5
Electricity & Water	82,894.5	1.2	67.4	97,225.4	1.2	20.0	114,033.7	1.2	8.9
Building & Construction	261,453.0	3.8	15.2	328,639.3	4.1	12.0	413,090.7	4.3	12.9
Commerce, Restaurant & Hotels	1,077,313.8	15.7	2.8	1,266,468.6	15.7	4.5	1,488,835.2	15.6	5.6
Transport & Communication	841,053.7	12.2	9.0	977,321.2	12.1	8.5	1,135,666.8	11.9	8.6
Finance, Insurance, Real-estate & Business Services	529,999.5	7.7	4.2	617,287.8	7.6	8.5	718,951.9	7.5	8.9
Community, Social & Personal Services	91,669.2	1.3	6.4	103,480.8	1.3	5.0	116,814.4	1.2	5.5
Nominal Finance Institutions	-53,921.1	-0.8	3.5	-59,714.6	-0.7	3.3	-66,130.6	-0.7	3.5
Government Services	384,556.0	5.6	23.3	453,910.7	5.6	20.0	535,773.6	5.6	11.8
Producers of Private Non-profit Services to Households	70,786.2	1.0	5.4	80,128.3	1.0	5.0	90,703.3	1.0	5.3
Import Duties	118,800.0	1.7	39.6	137,338.8	1.7	2.0	158,770.7	1.7	2.5
Total	6,868,882.5	100.0	7.4	8,076,322.4	100.0	8.7	9,530,361.1	100.0	9.4
GDP per capita (SD)	199,028.8		4.7	228,164.0		6.0	262,566.1		6.7

* Growth Rate of GDP at Constant Market Prices Base
Source : Statistical Yearbook for the Year 2006, Central Bureau of Statistics

Table 2.3.2-2 shows the major economic indicators in the "World Development Indicators Database" prepared by the World Bank. This table also shows a high GDP growth rate in recent years, approximately 10 % p.a.

Table 2.3.2-2 Economic Indicators

	2000	2005	2006	2007
GNI (billion US$)	10.27	22.94	29.25	37.03
GNI per capita (US$)	310	620	780	960
GDP (billion US$)	12.37	27.39	36.40	47.63
GDP Growth Rate (annual %)	8.4	6.3	11.3	10.2
Inflation, GDP deflator (annual %)	8.7	12.2	6.5	7.0
GDP per capita (US$)	371	742	965	1,235

Source : World Development Indicators Database, September 2008, World Bank

There is no official information/data on the GDP of the Southern Sudan nor the GRDP in the study area (Juba urban area). The report, "Towards a Baseline : Best Estimates of Social Indicators for Southern Sudan" prepared by NSCSE (New Sudan Centre for Statistics and Evaluation) in association with UNICEF, May 2004 says that :

- The Gross National Income (GNI) per capita in SOSUS (Southern Sudan SPLM areas) is estimated to be less than US$90 per year (in 2001) and makes SOSUS alongside the poorest countries in the world. SOSUS income is about four times lower than the level of the rest of Sudan. (GNI per capita of Sudan in 2001 is US$350.)
- The proportion of the population earning less than one dollar a day in SOSUS is around 90 %, putting SOSUS among the poorest regions in the world.

The above estimate is for the year 2001, before the signing the Comprehensive Peace Agreement (CPA), and the situation has improved now. However, the recovery movements are still in the initial stage and the income per capita at present must be still far behind the Sudan average.

Assuming that GRDP per capita in the study area is one third of that in the whole Sudan, the GRDP of the study area in 2008 is roughly estimated as follows :

- GDP of Sudan at current price in 2008 : US$47.63 billion in 2007 x 1.3 = US$61.9 billion (assuming 30 % of economic growth and inflation combined),
- GDP per capita of Sudan : US$61.9 billion / 39,154,490 (2008 population, see Table 2.3.1-1) = US$1,580,
- GRDP per capita of the study area : approximately US$530 (1/3 of US$1,580),
- GRDP of the study area : US$530 x 260,000 = US$138 million, approximately US$140 million

2.3.3 Livelihood

The Southern Sudan Centre for Census, Statistics and Evaluation (SSCCSE) prepared the report entitled "Southern Sudan Livelihood Profiles (2nd Edition May 2007)", compiling existing livelihood baseline information. The report divides Southern Sudan into relatively homogeneous zones, defined according to a livelihoods framework. The following are the 7 livelihood zones (refer to Figure 2.3.3-1):

- Zone 1 : Western Flood Plains Zone
- Zone 2 : Eastern Flood Plains Zone
- Zone 3 : Nile and Sobat Rivers Zone
- Zone 4 : Ironstone Plateau Zone
- Zone 5 : Greenbelt Zone
- Zone 6 : Hills and Mountains Zone
- Zone 7 : Arid / Pastoral Zone

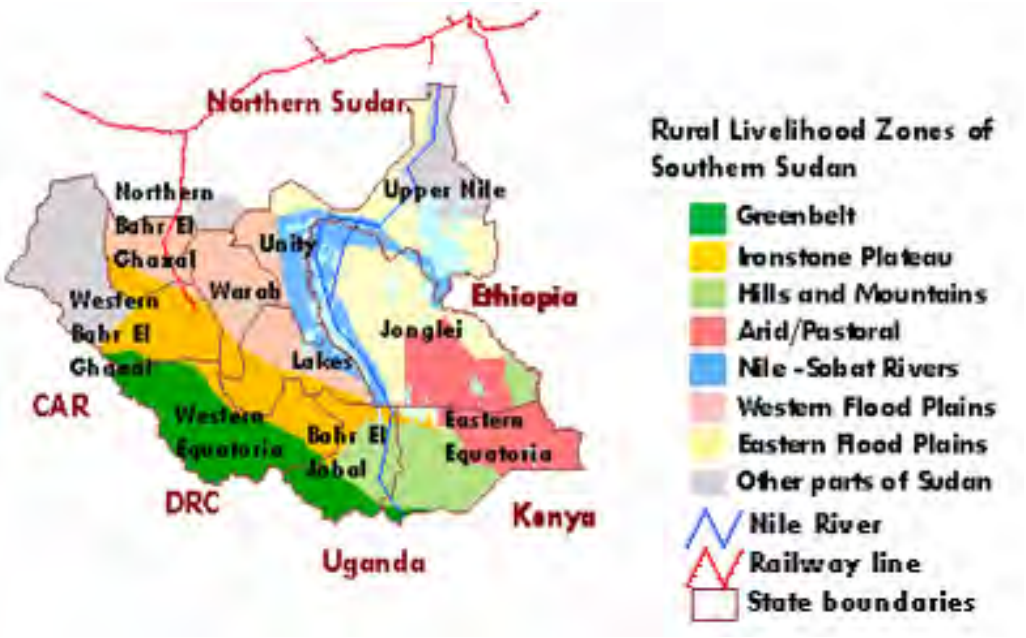


Figure 2.3.3-1 Livelihood Zones of Southern Sudan

Central Equatoria State stretches over three zones : Ironstone Plateau in the north and northwest, Greenbelt in the south, and Hills and Mountains in the central and east. Juba and its surrounding areas belong to Hills and Mountains Zone.

The Hills and Mountains Zone lies in the central to eastern side of Central Equatoria State and western side of Eastern Equatoria State and separately includes the eastern tip of Jonglei State. Two distinct rainy seasons and the relationships between highland and lowland systems give this zone some unique characteristics that have helped to sustain its food security through times of conflict. Agro-pastoralists normally use livestock as their safety net in difficult years as they can trade them for grain. More agriculturally based systems tend to depend on the reserves found in their root crops. This zone has the benefit of both options in addition to important trade and exchange options inherent in highland and lowland economies, and the seasonal and spatial variations that stimulate trade. Unfortunately, most of these options have been frequently disrupted by conflict, but given a sustained peace following the signing of the CPA in early 2005, this zone should experience a re-strengthening of the traditional resilience of its agro-pastoral livelihoods.

Crops, livestock and grain from trade form the main sources of food for the residents of this zone. Main sources of income in this zone are trade in livestock (45% of better-off households), followed by crops, petty trade and milk sales (32%, 9% and 9% respectively of better-off households). Labor is an important income source for the poor (about 40 %), who typically work on the farms of their middle and better-off neighbors.

The above-mentioned is the general profile of the zone, mainly for rural areas. On the other hand, the livelihood profile in the urbanized area is far different. In Juba Town, approximately 45 % of the working population is engaged in public sector, whereas those in agricultural sector accounted for 15 %, commercial 9%, transport 8 %, construction 7% and manufacturing 6% in 1973, according to the 1973 Census.

CHAPTER 3

PRESENT CONDITION OF URBAN TRANSPORT INFRASTRUCTURES

CHAPTER 3 PRESENT CONDITION OF URBAN TRANSPORT INFRASTRUCTURES

3.1 TRANSPORT SYSTEM

The transport sector in Southern Sudan is basically composed of four major modes, namely: roads, railways, inland water and air transport.

(1) Roads

It is estimated that Southern Sudan has a road network of about 12,642 km consisting of 7,369 km of interstate roads, 1,451 km of state primary roads and 3,822 km state secondary roads. Most of these roads are in bad condition as they have not been maintained during the long civil war. A few roads of the interstate and primary road have been improved to gravel roads. The road networks of Southern Sudan and Juba are described in Section 3.2.

(2)Railways

Southern Sudan is connected only to the Bananusa-Aweil-Wau railway line. However this railway has not been operational since 1991. Although rehabilitation and extension of the railway line will require a feasibility study to determine the potential for the railway service as an alternative transport mode, there is no detailed plan yet to connect Juba with the railway network.

(3) Inland water transport

The Nile River, traversing Sudan from South to North, provides an important inland transport route.

At present only two sections of the Nile have commercial transport services. The major important route is the 500km stretch of the White Nile from Kosty to Malakal, which is served regularly. Occasional services are also being provided between Malakal and Juba by the River Transport Corporation (RTC), a distance of 936 km.

In Juba, there are several existing ports - an old port, a new port and a small wharf for small private boats. The old port has not been used due to the heavy sedimentation that has made river navigation impossible. The small wharf is located 200m downstream of the old port on the tributary of the Nile River.

The new river port is located 2km upstream of the old port on the river bank of the main stream of the Nile River. In 2007, this new port improvement project was conducted by JICA as a pilot project.

New river port

New port improvement project by JICA

(4) Air Transport

Air transport in Southern Sudan is inadequate with Juba airport as the only airport that receives limited international flights.

The existing Juba International Airport is located at 2km north of the Juba Old Town. The airport is administrated by South Sudan Airport Authority under the Ministry of Transport and Road, GOSS since 2006. Two 2,500m runways of concrete pavement are running in parallel in northwest – southeast direction.

Since present location of Juba International Airport is very close to the old built-up area, it causes problems of noise and urban development. A New Juba International Airport Construction Project is proposed at eastern bank of the Nile River.

3.2 ROAD NETWORK AND CONDITION

3.2.1 Road Network

(1) Administrative Road Classification

A functional road classification is not yet established in Sudan; hence the various road agencies do not know their delegated responsibilities for the road network. However the MTR will carry out the classification of all roads in Southern Sudan in liaison with the Southern Sudan Road Agency.

The road network in Southern Sudan is classified in order of importance as follows.

Table 3.2.1-1 Road Type and Responsible Organization

Road Type	Responsible Organization
International/Interstate Road	GOSS, Ministry of Transport and Roads (MTR)
State Road	State, Ministry of Physical Infrastructure (MOPI)
County Road	County

Presently all roads including interstate/international roads, distributer roads and feeder roads in Juba are planned and constructed through funding of GOSS (MTR), since Juba has important roles as the capital city in Southern Sudan and settlement of IDP.

The GOSS is in the process of establishing the following institutions to fund and manage the road network in Southern Sudan.

Table 3.2.1-2 Proposed Institution and Function

Institution	Function
SSRB: Southern Sudan Road Board	Responsible for fund management for development and maintenance of the entire Southern Sudan road network
SSRA: Southern Sudan Road Agency	Responsible for the administration, control, development, and maintenance of Interstate and International roads and related structures
SRA: State Road Agency	Responsible for the administration, control, development, and maintenance of Primary and Secondary State roads and related structures
SSURA: Southern Sudan Urban Road Agency	Responsible for the administration, control, development, and maintenance of all roads and related complementary infrastructure within the areas of agency of city in Southern Sudan
SSCRA: Southern Sudan County Road Agency	Responsible for the administration, control, development, and maintenance of secondary roads and below and small town roads.

Source: STRATEGIC PLAN FOR ROAD SECTOR,MINISTRY OF TRANSPORT AND ROADS, July 2006

(2) International / Interstate Road Network

Figure 3.2.1-1 shows the arterial roads to connect Juba with the neighboring regions and countries. Although the Southern Sudan is bordered by several countries including Ethiopia, Kenya, Uganda, Congo and Central Africa, the main roads in Southern Sudan are internationally linked with Uganda and Kenya. There are two main routes that connects Southern Sudan with Uganda: the Juba-Yei - Kaya and the Juba - Nimule Roads. Yei - Kaya link has become the main corridor on the west bank of the White Nile connecting westwards to Maridi - Yambio - Tambura and northtoward to Mundri - Rumbek - Tonj - Wau - Aweil. Juba-Nimule Road is being rehabilitated with DBST(double bituminous surface treatment) pavement. The other international road link is Juba-Kapoeta connected to Likichogio in Kenya.

The conditions of other arterial roads have deteriorated due to long time negligence and apparently no maintenance during civil war.

Figure 3.2.1-1 International Road Network

Figure 3.2.1-2 and Table 3.2.1-3 shows the arterial roads in Central Equatoria State (CES), showing Juba being at the center of CES. Six primary roads form the radial road network from Juba to other towns, namely, Bor, Torit, Nimule, Kajo keji,Yei and Mundri. As seen in Figure 3.2.1-2, Juba has an important role as a transport hub to carry the passenger and freight traffic in Southern Sudan.

Figure 3.2.1-2 Interstate Road Network

Table 3.2.1-3 Road List in Central Equatoria

Road Class		Name of the Road	Length(km)
Interstate	P1	Juba-Mundri-Yambio-Tambura-Wau	586
Interstate	P2	Juba-Yei	160
Interstate	P3	Juba-Bor	174
Interstate	P4	Juba-Torit -Kapoeta - (Nadpul) Narus	407
Interstate	P5	Juba-Moli-Nimule	171
State	P6	Juba-Kajo keji	145
State	S1	Terekeka-Tindalo	207
State	S2	Terekeka-Juba Junction	68
State	S3	Lainya-Rokon	92
State	S4	Kajo keji-Shukoli	13
State	S5	Galumbo-Kanchu	46
State	S6	Akeu-Tali-Border	61
P1, P2, P3, P4, P5, P6: Primary Road S1, S2, S3, S4, S5, S6: Secondary Road			

Source: Strategic Plan for Road Sector, Ministry of Transport and Roads, July 2006

(3) Juba Urban Road Network

As shown in Figure 3.2.1-3 and 3.2.1-4, the road network in Juba urban area consists of radial roads and circumferential roads.

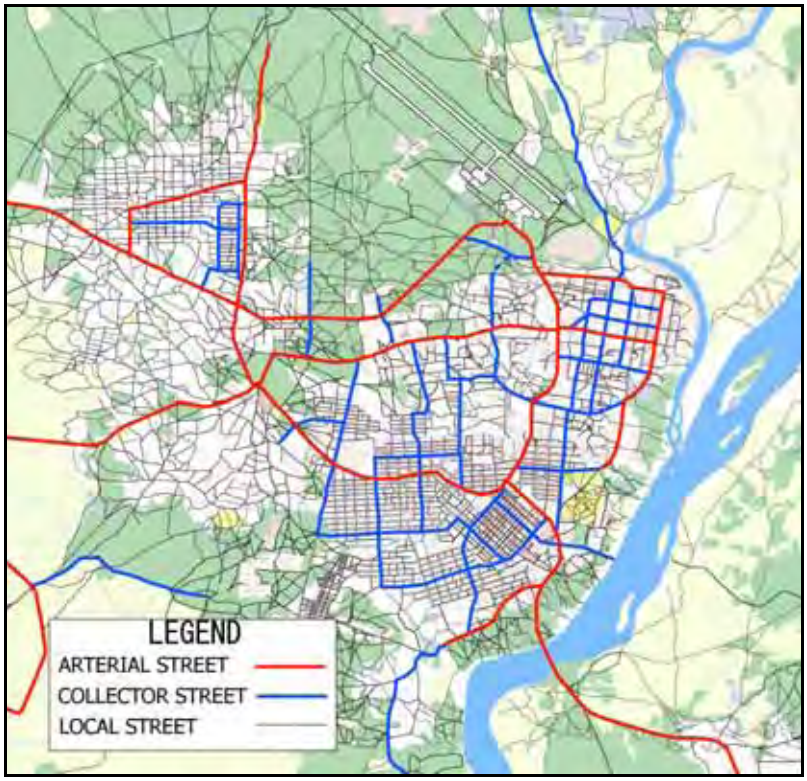


Figure 3.2.1-3 Present Road Network in Juba

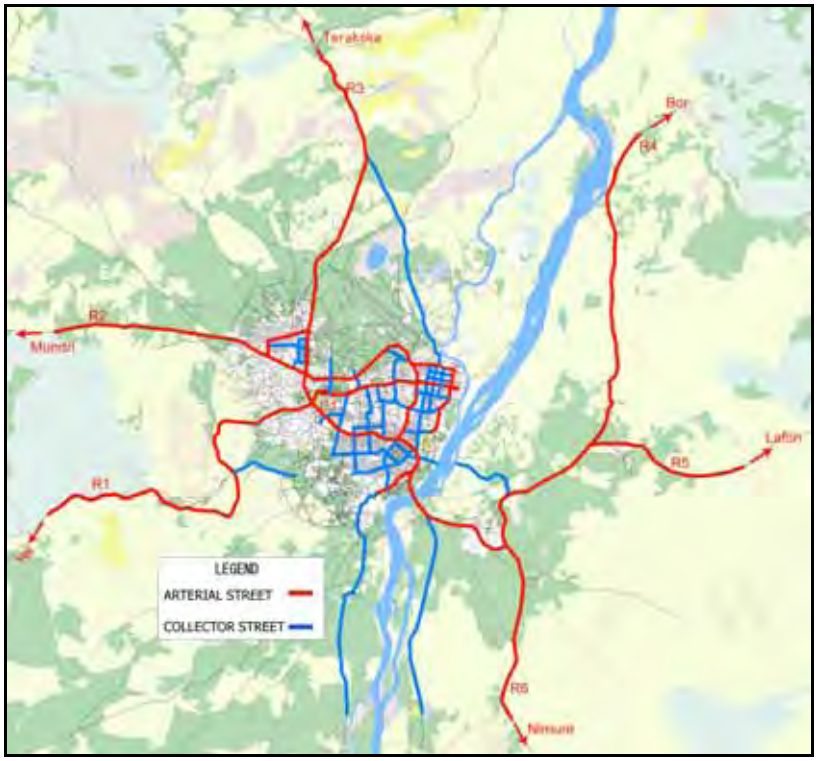


Figure 3.2.1-4 Present Road Network in Juba and Surrounding Area

Radial Road

The road network in Juba urban area consists of six arterial roads that handle mainly international, interstate and inter-city traffic.

All radial roads start from Juba to the suburbs and surrounding cities. Table 3.2.1-4 presents the destinations at the arterial roads which are also shown in Figure 3.2.1-4.

Table 3.2.1-4 Summary of Arterial Radial Roads

No	Road Name	Direction from Juba	Connection
R-1	Juba-Yei	To south-west	Juba to Yei /UGANDA
R-2	Juba-Mundri	To west	Juba to Mundri / Yambio/ Tambura /Rumbek/Wau
R-3	Juba-Terekeka	To north	Jutba to Terekeka
R-4	Juba-Bor	To north-east	Juba to Bor / Pochalla / ETHIOPIA
R-5	Juba-Lafon	To east	Juba to Lafon
R-6	Juba-Nimule	To south-east	Juba to Nimule / UGANDA, Kapoeta /KENYA

Circumferential Road

Presently, there is only one completed circumferential road (C-1) in Juba urban area. A 3-km section of C-3 road originating from Juba-Yei road was constructed at the southern area of Juba. Table 3.2.1-5 presents information of the circumferential roads.

Table 3.2.1-5 Summary of Arterial Circumferential Roads

No	Road Name	Radius	Connection
C-1	Unity Ave. and Old Airport road	R=1~2 km (Total Length = 9.5km)	R-1(Juba-Yei) ,R2(Juba-Mundri) R-3(Juba-Terekeka) ,R6(Juba-Nimule)
C-2	N/A	-	-
C-3	South section (Yei road to Kator)	R=5km in the south side (Total Length = 3km)	R-1(Juba-Yei)
C-4	N/A		

3.2.2 Intersection

The major intersections are shown in Figure 3.2.2-1 and their present conditions are shown in Table 3.2.2-1. These intersections are identified as future bottlenecks that need improvement. Presently the roundabout with Unity Avenue and May Street (No.5) has a long queue of traffic. Although other junctions have not yet indicated traffic congestion, it is expected to become a bottleneck as the traffic increases in the future.

Table 3.2.2-1 Major Intersection Conditions

No.	Name	No. of legs	Conditions
1	Old Custom Market	4	Roundabout
2	Junction with May St. –Juba uni. Road	4	Roundabout with broken Signal
3	Junction with Unity Ave.-Torit Rd.	3	T-intersection
4	Junction with Unity Ave.-Addis Ababa St.	4	Roundabout
5	Junction with Unity Ave.-May St..	4	Roundabout
6	Junction with Addis Ababa St.-	3	T-intersection
7	Konyo Konyo Market	4	Roundabout
8	Juba Market Roundabout	4	Roundabout, one-way
9	Junction with May St.- Juba Uni. Rd.	3	T-intersection
10	Junction with Unity Ave.- Old Airport St.	4	Roundabout
11	Legislative Assembly Roundabout	4	Roundabout

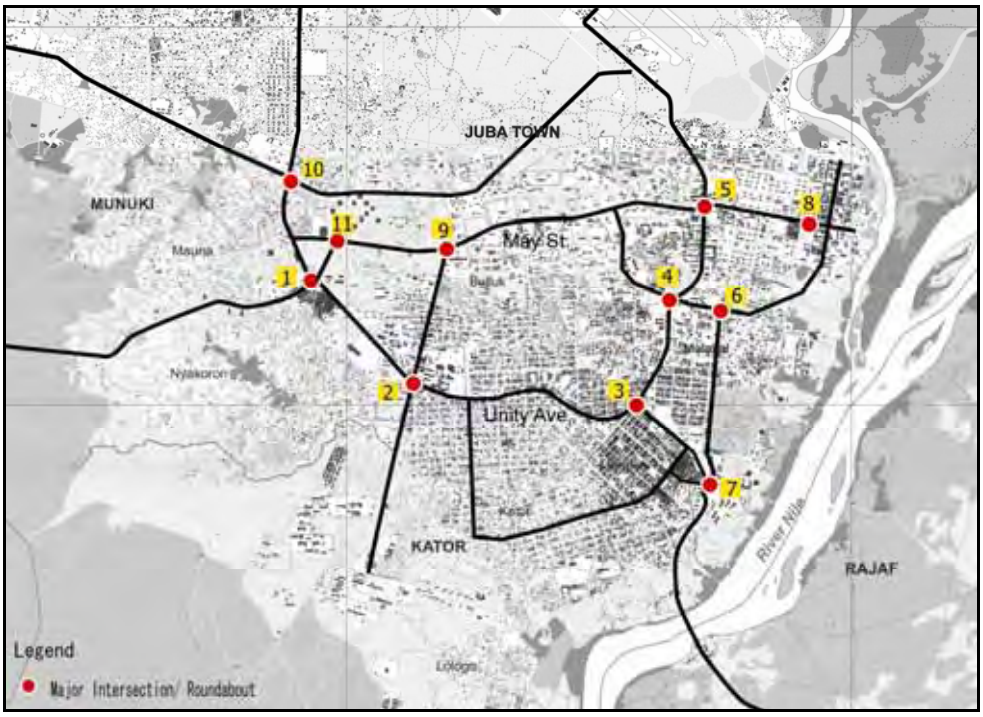


Figure 3.2.2-1 Location of Major Intersections in Juba

No.1 Custom Market Roundabout

No.2 Unity Ave.-Juba Uni. Roundabout

No.5 May St.- Unity Ave. Roundabout

No.11 Legislative Assembly Roundabout

3.2.3 Road Condition

To identify the present road network condition, road inventory survey was conducted by JICA Study Team in October 2008. The present road condition is shown in Figure 3.2.3-1. The routes of the inventory survey are shown in Figure 3.2.3-2 and the survey data are shown in Table 3.2.3-1.

May Street, Airport Road and a part of Unity Avenue is partially completed with pavement construction. The total length of these roads is about 6 km with good condition. In the Juba Central Commercial District, there are some old asphalt paved roads which have deteriorated due to long time negligence and lack of maintenance. Other roads are unpaved road and vehicles are forced to travel at a speed of under 30 km/h due to such bad surface condition. In the rainy season, some road sections crossing the rivers without bridge/culvert structures become impassible during and after rains. No attention is given to pedestrian and Non-Motorized Transport (NMT).

Due to the above road conditions and insufficient road network, the traffic tends to concentrate on the specific sections in good condition such as May Road, Airport Road and Unity Avenue. As a result, traffic congestion occurs presently at the intersection of May Street and Unity Avenue and this congestion will become more serious in the near future.

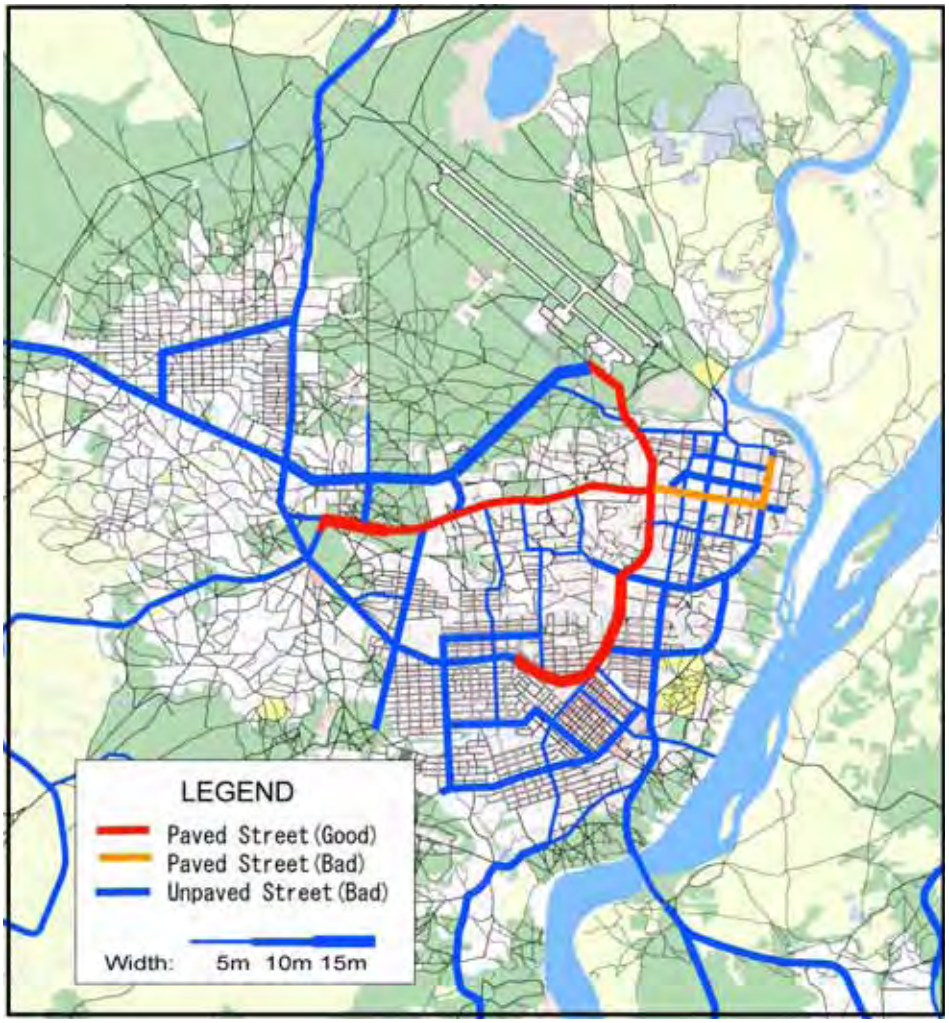


Figure 3.2.3-1 Road Condition (as of October 2008)

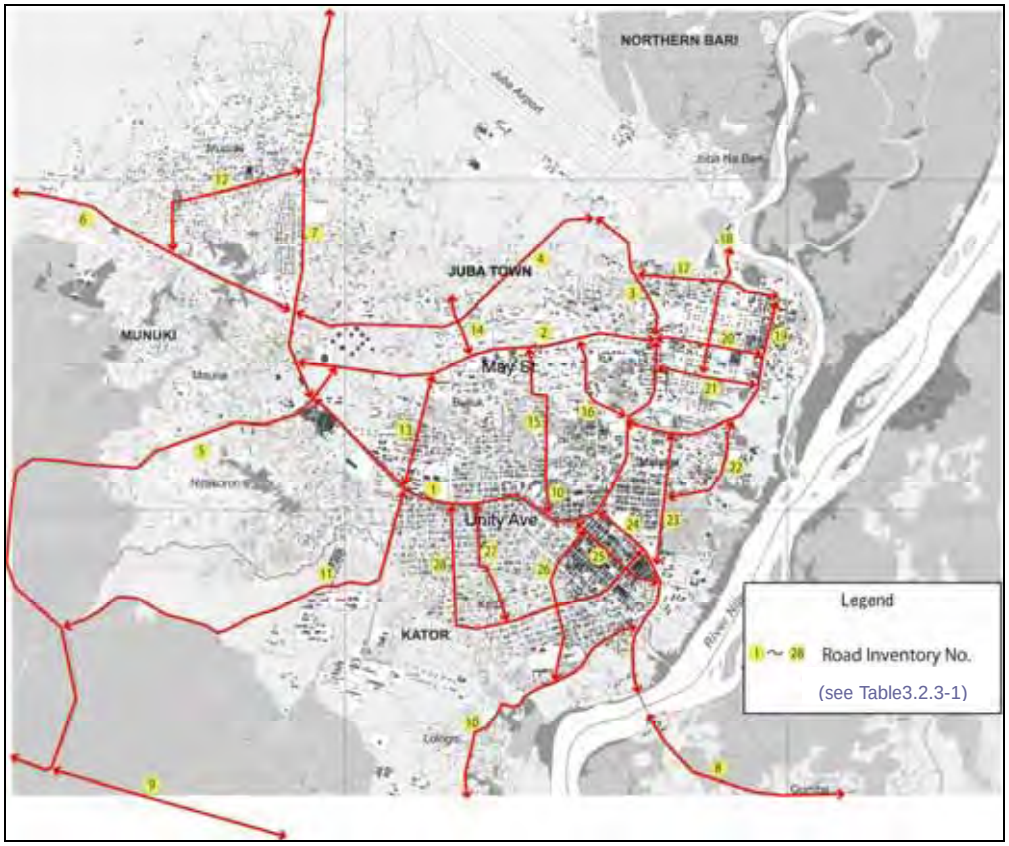


Figure 3.2.3-2 Route of Road Inventory Survey

May Street (newly paved with sidewalk)

Airport Road (newly paved with sidewalk)

Unity Avenue (Under construction)

C3 Road (Gravel, W=20m)

Table 3.2.3-1 Road Inventory Data in Juba

No.	Road	Length (km)	Carriageway Width(m)	Remarks
1	Unity Ave.	4.6	11.0-14.0	Paved and under construction(old custom market – Juba university)
2	May St.	3.3	10.9-14.0	Paved with both sidewalk(1.8m)
3	Airport Road	1.2	11.1	Paved
4	Old Airport Road	3.0	14-16.6	Unpaved
5	Yei Road	5.0	9.0	Unpaved
6	Junction of Seventh days Adventist - Gudele	2.9	11.0-13.0	Unpaved
7	Custom market- Terekera	5.4	10	Unpaved
8	Nile Bridge – Radio Gumba	3.0	15.1-18.0	Unpaved
9	C3	4.0	20.0	Unpaved
10	Lologo-Nile Bridge	3.8	10	Unpaved
11	Junction of Yei road – Juba Uni.	4.0	6.0-15.0	Unpaved
12	Munuki Area	1.8	8.0-10.0	Unpaved
13	Juba University Road	1.1	11.1	Unpaved
14	Road connecting UNDP – Tomping	0.4	11-15	Unpaved
15	Kokora St.	1.7	10	Unpaved
16	Mobile –May St.(via Totochan)	1.0	7-13	Unpaved
17	Gabad Jct. from Airport Road-Custom office	1.2	4.5-6.0	Unpaved
18	Youth Sport Office-WFP	1.9	10.5	Unpaved
19	Addis Ababa Road	2.1	9.9	Unpaved & Old Paved
20	Jct. Unity,May – MOPI	1.0	8-11	Old Paved
21	Juba Hospital – Prison	1.0	8-20	Unpaved
22	Football Stadium	1.2	9.2-16.0	Unpaved
23	Freedom Sq.-Cinema	1.4	9.2-21.9	Unpaved
24	Nyigilo St.	2.0	15-18	Unpaved
25	Kwait St.	1.0	22-35	Unpaved
26	Albino St.	1.6	10-18	Unpaved
27	Lazaro St. – Tombua St.	1.2	16-17.2	Unpaved
28	Tombura St.	3.1	16	Unpaved

3.2.4 Drainage Condition

There are no drainage systems in Juba urban area. Though May Street is a newly paved road and has open drain, there is no connection to the main channel /river to discharge rainwater. After heavy rainfall, rainwater flows on the drain and then discharges to the intersecting access roads. A schematic illustration of rainwater flow is shown in Figure 3.2.4-1.

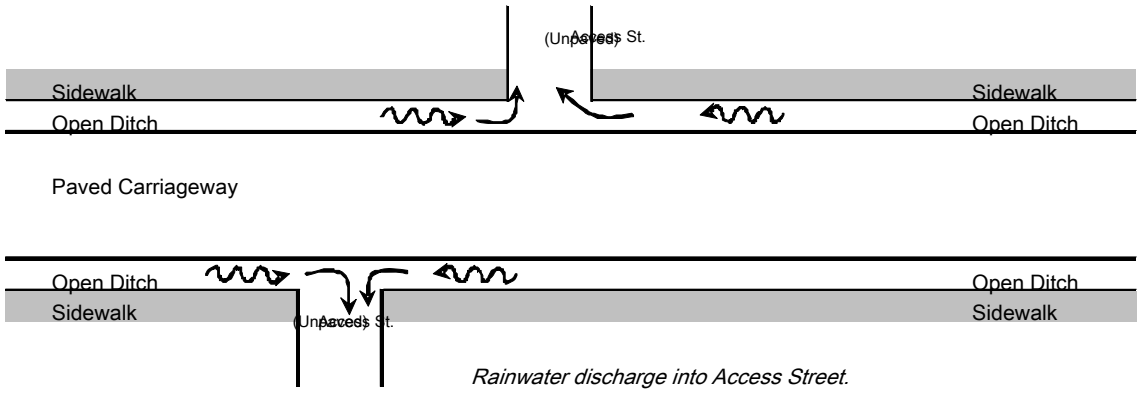


Figure 3.2.4-1 Image of Rainwater Flow on May Street

Regarding unpaved road in Juba urban area, its condition deteriorates seriously after heavy rain. Surface of unpaved street becomes bumpy and some sections retain a pool of rainwater in the road making it difficult for passing vehicles to traverse the road.

Unpaved Street (Bumpy Surface)

Puddle on the road

3.2.5 Bridge and Culvert Condition

As mentioned in the earlier sections, the road network in Juba urban area consists basically of international/interstate, state and county roads. Several streams and rivers cut through these roads with Lobulet and Korobo rivers flowing from west to east and discharging to the White Nile River. About 12 reinforced concrete bridges and culverts cross over these rivers and streams (Figure 3.2.5-1) and concrete and corrugated steel pipe culverts cross small streams. At present, there is only one bridge crossing over the Nile River to link Juba with the eastern side of the White Nile River.

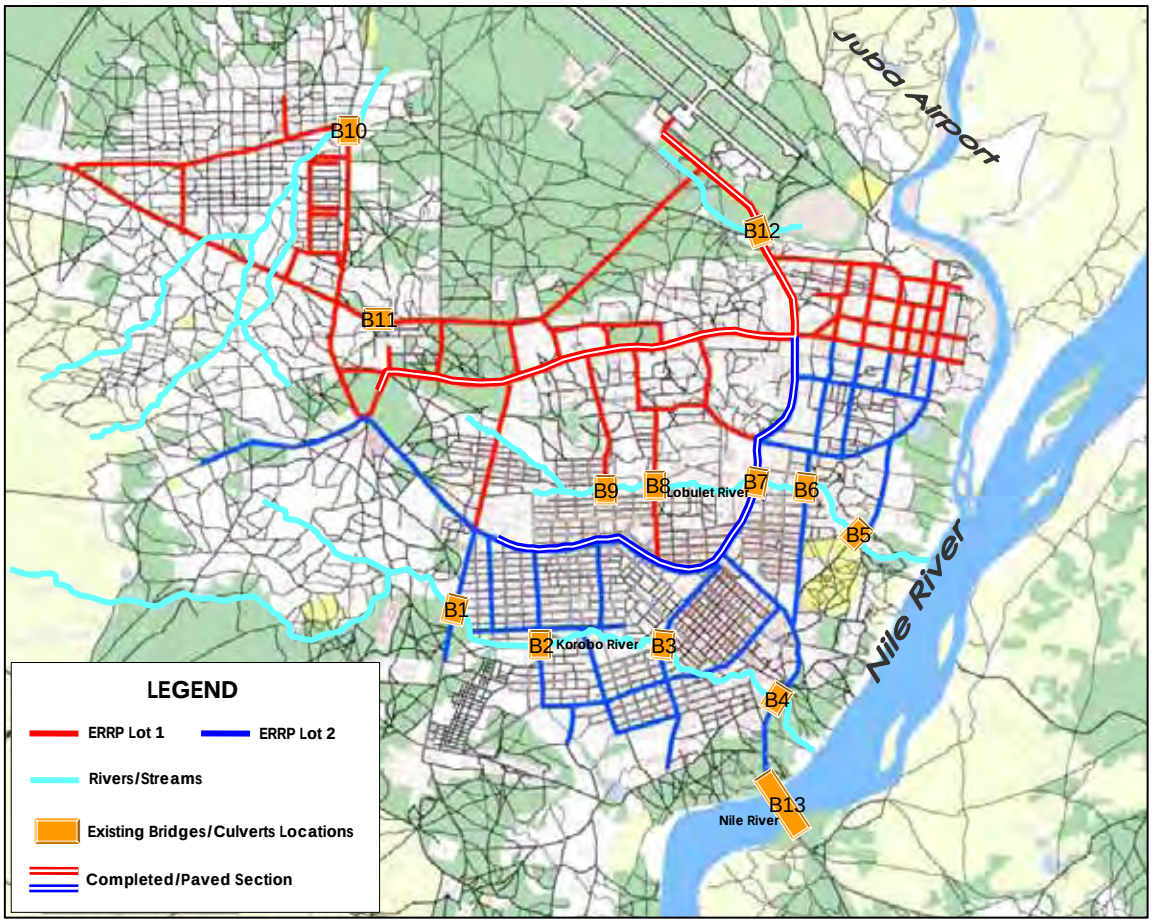


Figure 3.2.5-1 Existing Bridges/Culverts in Juba

(1) Existing Bridges and Culverts in Juba

Existing bridges in Juba are mostly one- or two-span reinforced concrete slab on steel H-beam with length ranging from 5.0m to 16.0m. These bridges are supported on masonry abutments with masonry wing walls. The existing conditions of these bridges are summarized as follows:

- Bridges were built in similar time period with similar structural configurations – as such, these bridges have similar load-carrying capacity.
- The superstructure shows signs of wearing and distress with some concrete cracks and damages on the deck slab.

- All bridges are found to be narrower than the existing roads, providing only one-lane or narrow two-lane traffic.
- The bridge centerline is basically offset from the approach road centerline providing risks to traffic accidents.
- Some bridges have freeboards less than 0.5m during flood.
- Scouring of banks and road embankments are observed in the upstream side of some bridges.

Existing culverts are basically one-cell and two-cell reinforced concrete slab on masonry abutment. The conditions of the culverts are similar to those of the bridges. The culvert along Terekeka Road (R-3 Road) is overtopped during flood. Table 3.2.5-1 presents a summary of the existing bridges and culverts in Juba. The details of the conditions of these bridges and culverts are discussed further in Part IV "Bridges and Culverts Reconstruction Project". Some typical short bridges and culverts are shown in the photos below.

Table 3.2.5-1 Summary of Existing Bridges and Culverts Conditions

No. (see Fig. 3.2.5 -1)	Bridge/ Culvert Name	Road Name	River	Bridge/Culvert Superstructure & Substructure Type	Bridge/ Culvert Length (m)	Year Built
B1	Shuhada	Mayo	Korobo	2-Span RCDHB on Masonry Abutment	13.0	1991
B2	Tombror	Tombror	Korobo	1-Span RCDHB on Masonry Abutment	5.9	1974
B3	Albino	Albino	Korobo	1-Span RCDHB on Masonry Abutment	5.95	1974
B4	Madra	Nglilo	Korobo	2-Span RCDHB on Masonry Abutment	15.7	1972
B5	Salakana	Salakana	Lobulet	1-Span RCDHB on Masonry Abutment	9.65	1995
B6	Hai Malakar	Cinema	Lobulet	1-Span RCDHB on Masonry Abutment	5.4	
B7	Korobo	Unity	Lobulet	1-Span RCDHB on Masonry Abutment	5.5	1960
B8	Kokora	Kokora	Lobulet	1-Span RCDHB on Masonry Abutment	10.5	1983
B9	Lukabadi	Lukabadi	Lobulet	2-Span RCDHB on Masonry Abutment	12.1	1999
B10	Terekeka	Terekeka	-	2-Cell RC Slab on Masonry Abutment	3.3	1950
B11	Gonya	Salvation	-	1-Cell RC Slab on Masonry Abutment	4.5	
B12	Lodoro	Lay	-	1-Cell RC Slab on Masonry Abutment	6.1	1986
B13	Juba	R6	Nile	6-Span Continuous Steel Truss	240	2008*

RC – Reinforced Concrete RCDHB – Reinforced Concrete Deck on Steel H-Beam

* Replacement of Superstructure for Juba Bridge was completed in 2008. Original substructure is retained.

Typical 1-Span RC Deck on Steel H-Beam with Masonry Abutments

Typical 2-Span RC Deck on Steel H-Beam with Masonry Abutments and Pier

Typical 1-Cell RC Slab with Masonry Abutments

Typical 2-Cell RC Slab with Masonry Abutments

Typical Corrugated Steel Pipe Culvert

Typical RC Pipe Culvert

(2) Existing Juba Bridge Crossing White Nile River

At present, only one bridge, Juba Bridge connects Juba with the eastern side of the White Nile River. This is an important bridge providing direct connection to the eastern states via the Juba-Bor, Juba-Lafon and Juba-Nimule roads towards Uganda. All movements of people and goods from the eastern side to Juba pass over this bridge.

The existing Juba Bridge, crossing over the White Nile River, is a twin-deck 6-span continuous steel truss bridge (Mabey and Johnson type) with double panels. Pedestrian walkways are provided on both sides of the bridge. The bridge is supported on five steel pile bent piers.

The original bridge was built in 1974 but collapsed in 2006 due to the constant passage of heavy trucks and lack of control of overloading. Following the bridge failure, a structural assessment was carried out by Mabey and Johnson in 2006. It was evaluated that the substructures (piers and foundations which are in very firm rock layer) were in good condition and that the need is only to replace the superstructure (steel truss and deck). Sudken International, a locally registered South Sudan company, was awarded the US$5.8 million contract for the superstructure replacement in August 2006. Delays in the release of funds from the Ministry of Finance caused the delay in the procurement of the structural

members. The bridge was finally completed and inaugurated in October 6, 2008. After completion of the superstructure replacement, the bridge load limit is posted at 45 tons and the maximum speed is limited to 20km/hr.

Juba Bridge over the White Nile River

Load Limit Posted at 45 Tons (20 km/hr) During Juba Bridge Inauguration (Oct. 6, 2008)

Steel Deck and Truss Panels

Double Truss Panel and Pedestrian Walkway at bridge side

Steel Pile Bent Piers

3.3 VEHICLE REGISTRATION

Vehicle registrations are controlled by the different authorities in GOSS and the State Traffic Police. As shown in Table 3.3-1, the GOSS vehicles and NGOs, aid agencies and diplomatic vehicles are controlled by MTR, GOSS. State government vehicles, private vehicles, motor cycles and commercial vehicles are controlled by the State Traffic police. Traffic police grasped only the number of vehicles given as plate number "CE****". Since many vehicles registered by GONU are seen in Juba, the number of registered vehicles do not match as actual numbers in Juba. A vehicle registration system that will be controlled by one organization in Southern Sudan should be established.

Table3.3-1 Vehicle Registration System and Number of Registered Vehicles

Category		Agency to register	Number of registered vehicles	Remarks
GOSS vehicles		MTR, GOSS	1,600	
NGOs, aid agencies and diplomatic missions vehicles		MTR, GOSS	210	Except those registered in Khartoum
State Government vehicles		Central Equatoria State, Traffic Police	100	
Private Vehicles		Central Equatoria State Traffic Police	1,724	Plate Number "CE-****" only.
Commercial Vehicles		Central Equatoria State Traffic Police	513	Bus, Truck
Motor-cycles	State Government	Central Equatoria State Traffic Police	65	
	Private	Central Equatoria State Traffic Police	935	

Source: Department of Transport and Safety, MTR and Traffic Police

3.4 TRAFFIC MANAGEMENT

No traffic signal is installed in Juba. Presently, some roundabouts/ junctions are manually controlled by traffic police during peak hour.

During daytime, long queue occurs at Roundabout with May St. and Unity Ave.

Traffic in Juba is being controlled by the traffic police.

An one-way system is introduced into 3 short sections in Juba to maximize the limited road space illustrated in Figure 3.4-1.

Figure 3.4-1 Existing Traffic Management in Juba

3.5 PUBLIC TRANSPORT

(1) Bus

The bus terminals are located beside market places, such as Juba, Custom, Konyo-konyo, Muniki, Gudele, Gumba as shown in Figure 3.5-1. The public transport services between the bus terminals and other places are provided by minivans. Most of minivans are operated by individuals, and not by company. In order to operate minivans as public transport, the registration to traffic police is required.

The number of registered minivans is 513 vehicles. Since this figure includes trucks as commercial vehicles, it is difficult to grasp the actual number of minivans operating in Juba.

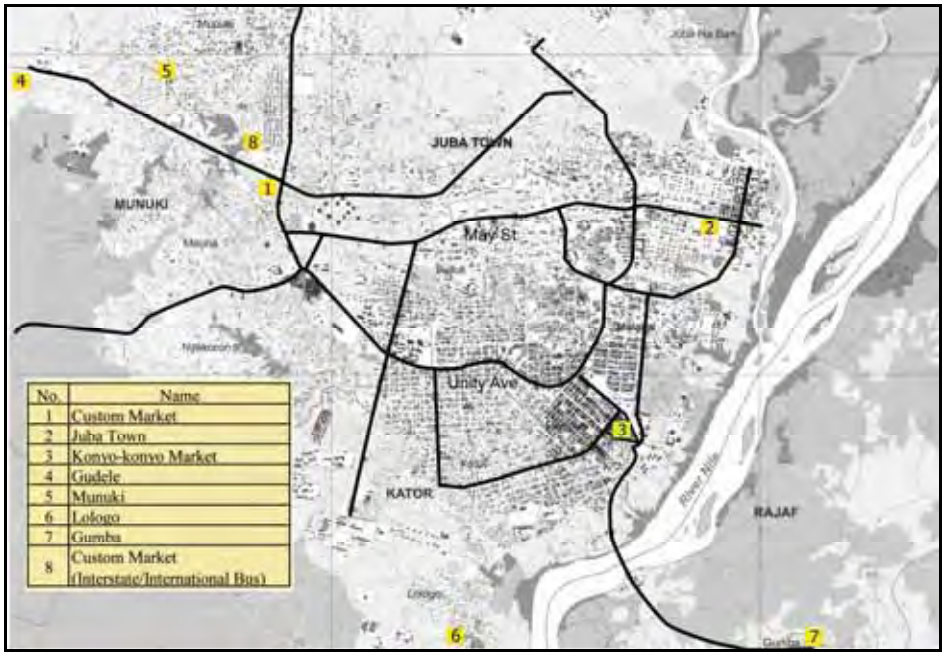


Figure 3.5-1 Location of Bus Terminal

No.1 Bus Terminal in Custom Market

No.3 Bus Terminal in Konyo Konyo Market

No2. Bus Terminal in Juba

No.8 International/Interstate Bus Company (near Custom Market)

Interstate/International bus is administrated by the Department of Road Transport and Safety, MTR. Most of these buses start from/to the terminal beside Custom Market and the Interstate/International bus are operated by the following bus companies.

Table 3.5-1 Interstate/International Bus Operation from/to Juba

	Bus Company Name	Route	Number of Bus	Seat Capacity	Fare(one-way) SDG
1	1.MUNDRI EXPRESS	Juba- Mundri - Yei	1	60	60
2	NATONDIT	Juba - Nimule - Kampala	2	60	70
3	GATEWAY	Juba - Nimule - Kampala	1	60	70
4	GRACE	Juba - Nimule - Kampala	1	60	70
5	VICTORIA NILE SAFARI	Juba - Nimule - Kampala	1	60	70
6	GATANI STAR	Juba - Nimule - Kampala	1	60	60
7	BLUE NILE COMPANY	Juba - Nimule - Kampala	6	60	120
8	NIMULE EXPRESS	Juba-Nimule	1	24	50
9	NILE COACH COMPANY	Juba - Yei - Kampala	2	60	100
		Juba - Aulu	2	60	50
10	YEI EXPRESS	Juba-Yei	1	60	50
11	Mini Bus Company	Juba - Yei	7	24	35

Source: Bus company interview survey by JICA Study Team

Minivans (Seat Capacity 14)

International Bus(Seat Capacity 60)

(2) Taxi

Another public transport available in Juba is the taxi. The taxi type is divided into sedan type and bike type. The bike taxis called *boda-boda* is more popular and many bike taxis wait for passenger at the main bus terminals as para-transit mode. There is no registration system and responsible organization which controls and operates the taxi service.

Bike Taxi (*boda-boda*) in Custom Market

(3) License System

The law/regulation on licensing of buses and taxis is not established yet. Buses and taxis are presently operated arbitrarily.