

MINISTRY OF PUBLIC WORKS AND TRANSPORT,  
THE KINGDOM OF CAMBODIA

**THE STUDY**  
**ON**  
**THE ROAD NETWORK DEVELOPMENT**  
**IN**  
**THE KINGDOM OF CAMBODIA**

**FINAL REPORT**

**VOLUME II**  
**MAIN TEXT**

OCTOBER 2006

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIPPON KOEI CO., LTD.

KATAHIRA & ENGINEERS INTERNATIONAL

CMO
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06-008

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## **The Study on the Road Network Development in the Kingdom of Cambodia**

### **Composition of Final Report**

Volume I Summary

Volume II Main Text

(1) Master Plan Study for the Road Network Development

[Part A Infrastructure Development for Road Network]

[Part B Institutional Development for Road Maintenance]

[Part C Capacity Development]

(2) Pre-Feasibility Study on the High Priority Projects

[Package A Improvement of NR.57]

[Package B Urgent Bridge Rehabilitation Program]

Volume III Drawings

[Package A Improvement of NR.57]

[Package B Urgent Bridge Rehabilitation Program]

Volume IV Data Book

### **Exchange Rates**

US\$ 1.00=KHR 4,113.5

## **PREFACE**

In response to the request from the Government of the Kingdom of Cambodia, the Government of Japan decided to conduct the Study on the Road Network Development in the Kingdom of Cambodia, and entrusted the Study to the Japan International Cooperation Agency (JICA).

JICA sent the Study Team, headed by Mr. Hiroki SHINKAI of Nippon Koei Co., Ltd. and organized by Nippon Koei Co., Ltd. and Katahira & Engineers International, to Cambodia three times from March 2005 to July 2006.

The Study Team had a series of discussions with the officials concerned of the Government of the Kingdom of Cambodia and Ministry of Public Works and Transport and conducted related field surveys. After returning to Japan, the Study Team conducted further studies and compiled the final results in this report.

I hope that this report will contribute to the promotion of the plan and to the enhancement of amity between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Kingdom of Cambodia, Ministry of Public Works and Transport for their close cooperation throughout the Study.

October, 2006

Takashi KANEKO  
Vice President  
Japan International Cooperation Agency

October, 2006

Mr. Takashi KANEKO  
Vice President,  
Japan International Cooperation Agency  
Tokyo, Japan

### **LETTER OF TRANSMITTAL**

We are pleased to submit to you the report on the Study on the Road Network Development in the Kingdom of Cambodia. The report compiled all findings obtained through the study from March 2005 to July 2006 in Cambodia conducted by Nippon Koei Co., Ltd. and Katahira & Engineers International in accordance with the contract with Japan International Cooperation Agency.

The report contains a master plan and a pre-feasibility study parts. The master plan proposes the road network development plan aiming at the year of 2020 based on the realistic and practical implementation plan taking into consideration financial plan. The subsequent pre-feasibility study on high priority projects concludes that the proposed projects will be technically and economically feasible and will be acceptable from the environmental aspects, and will contribute to the improvement of road situation in Cambodia.

We wish to take this opportunity to express our sincere gratitude to your agency and the Ministry of Foreign Affairs, and also wish to express our deep appreciation to the Government agencies concerned in the Kingdom of Cambodia, especially the counterpart agency of the Ministry of Public Works and Transport, for the close cooperation and assistance extended to us during the study.

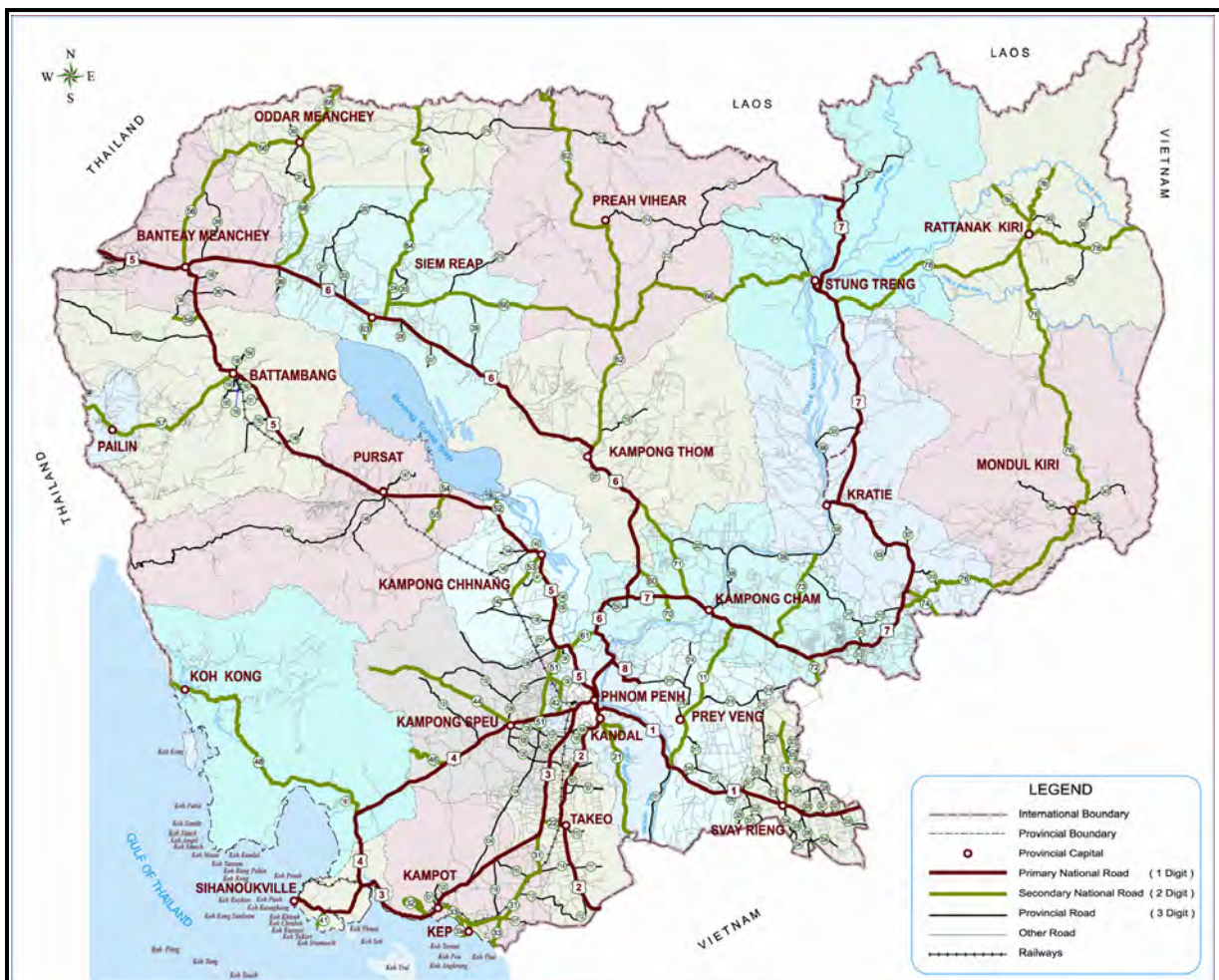
We hope this report will contribute to the development of the Kingdom Cambodia.

Very truly yours,

Hiroki SHINKAI

Team Leader

The Study on the Road Network Development  
in the Kingdom of Cambodia

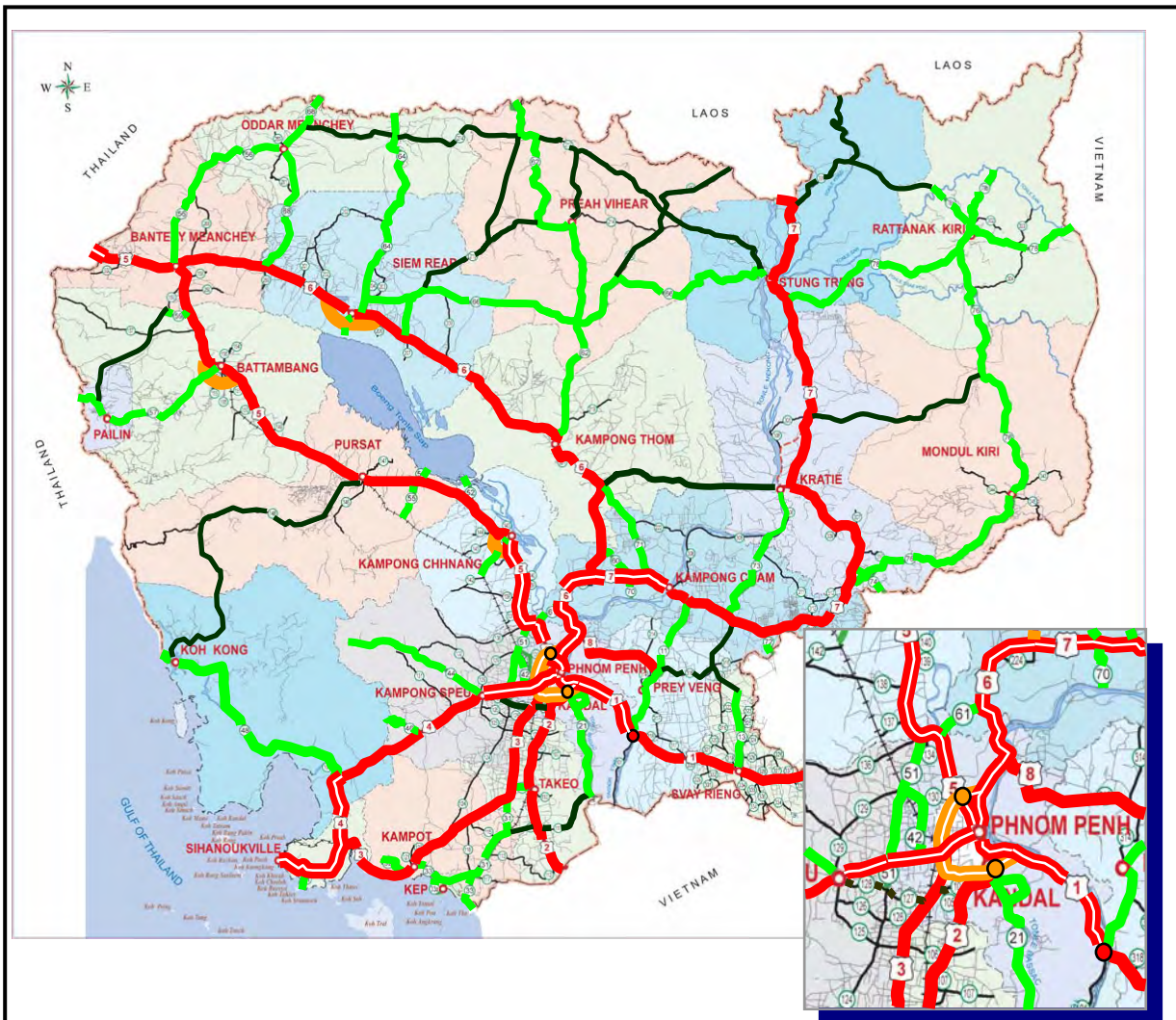


**LOCATION MAP**







**EXISTING ROAD NETWORK IN CAMBODIA**

1-DIGIT NATIONAL ROADS	2,052km
2-DIGIT NATIONAL ROADS	2,643km
PROVINCIAL ROADS	6,615km
RURAL ROADS	18,948km
<b>TOTAL</b>	<b>30,258km</b>

**STUDY ON THE ROAD NETWORK DEVELOPMENT  
 IN THE KINGDOM OF CAMBODIA**



ROAD NETWORK DEVELOPMENT PLAN

ROAD CLASSIFICATION		SECTION TO BE IMPROVED		MAINTENANCE WORK ONLY	TOTAL	
1-DIGIT NATIONAL ROADS		4-LANE	455km	0km	2,052km	
		2-LANE	1,597km	0km		
2-DIGIT NATIONAL ROADS			2-LANE	2,643km	0km	2,643km
PROVINCIAL ROADS			2-LANE	1,554km	5,061km	6,615km
RURAL ROADS			2-LANE	0km	18,948km	18,948km
NEW ROADS	RING ROAD		4-LANE	50km	0km	50km
	BYPASSES		2-LANE	80km	0km	80km
NEW BRIDGES			2-LANE	3km.	0km	3km
TOTAL						30,391km

**THE STUDY ON THE ROAD NETWORK DEVELOPMENT  
IN  
THE KINGDOM OF CAMBODIA**

**FINAL REPORT  
VOLUME II MAIN TEXT  
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## **LIST OF ABBREVIATIONS**

AADT:	Annual Average Daily Traffic
AASHTO:	American Association of State Highways and Transportation Officials
AC:	Asphalt Concrete
ADB:	Asian Development Bank
AH:	Asian Highway
AHS:	Asian Highway Standard
ASEAN:	Association of SouthEast Asian Nations
AusAID:	Australian Agency for International Development
AS:	Australian Standard
BCR (B/C Ratio):	Benefit Cost Ratio
BCU:	Bridge Construction Unit
BHN:	Basic Human Needs
BM:	Bench Mark
BR:	Bridge
BVOC:	Basic Vehicle Operating Cost
CBDS:	Cambodian Bridge Design Standard
CBR:	California Bearing Ratio
CBTA:	Cross-Border Transport Agreement
CDC:	Council for the Development of Cambodia
CLV:	Cambodia, Laos and Vietnam
CMAA:	Cambodian Mine Action and Victim Assistance Authority
CMAC:	Cambodian Mines Action Center
CMVIS:	Cambodia Mine/UXO Victim Information System
CP:	Counterpart
CRDS:	Cambodian Road Design Standard
DBST:	Double Bituminous Surface Treatment
DD:	Detailed Design
DFL:	Design Flood Level
DF/R:	Draft Final Report
DMS:	Detailed Measurement Survey
DPWT:	Department of Public Works and Transport
DRI (DOR):	Department of Road Infrastructure
DRR:	Department of Rural Roads
DU:	Demining Unit
DTM:	Digital Terrain Models
EIA:	Environmental Impact Assessment
EIRR:	Economic Internal Rate of Return

EMP:	Environmental Management Plan
ESAL:	Equivalent Single Axle Load
F/R:	Final Report
F/S:	Feasibility Study
FIRR:	Financial Internal Rate of Return
FRMR:	Fund for Road Maintenance and Repair
FYMAP:	Five Year Mine Action Plan
GDP:	Gross Domestic Product
GIS:	Geographical Information System
GMS:	Greater Mekong Sub-region
GoJ:	Government of Japan
GPC:	Ground Control Points
GPS:	Global Positioning System
GRDP:	Gross Regional Domestic Product
H/A:	Highway/Arterial
HCM:	Highway Capacity Manual
HEC:	Heavy Equipment Center
H/MA:	Highway/Minor Arterial
HIV/AIDS:	Human Immunodeficiency Virus / Acquired Immunodeficiency Syndrome
HLP:	Heavy Load Platform
HV:	Heavy Vehicles
HWL:	High Water Level
IC/R:	Inception Report
IDA:	International Development Association
IDP:	Internally Displaced People
IEE:	Initial Environmental Examination
IEIA:	Initial Environmental Impact Assessment
IH:	International Highway
ILO:	International Labor Organization
IMC:	Inter-Ministerial Committee
IRC:	Inter-ministerial Resettlement Committee
IRITWG:	Infrastructure and Regional Integration Technical Working Group
IT/R:	Interim Report
JICA:	Japan International Cooperation Agency
JRA:	Japan Road Association
LOS:	Level of Services
JRSO:	Japan Road Structure Ordinance
LRCS:	Location Referencing and Condition Survey (by World Bank)
LV:	Light Vehicles
M/P:	Master Plan

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MAFF:	Ministry of Agriculture Forestry and Fishery
MC:	Motorcycles
MCTU:	UN Mine Clearance Training Unit
MEF:	Ministry of Economy and Finance
MLMUPC:	Ministry of Land Management, Urban Planning & Construction
MOE:	Ministry of Environment
MOI:	Ministry of Interior
MOP:	Ministry of Planning
MOWRAM:	Ministry of Water Resources and Meteorology
MPWT:	Ministry of Public Works and Transport
MR:	Modulus Ratio
MRD:	Ministry of Rural Development
MSL:	Mean Sea Level
NA:	National Assembly
NGO:	Non Governmental Organization
NIS:	National Statistical Center
NMAD:	National Mine Action Database
NPRS:	National Poverty Reduction Strategy
NPV:	Net Present Value
NR:	National Road
NRMC:	National Road Maintenance Committee
NSDP:	National Strategic Development Plan
OD Survey:	Origin-Destination Survey
PAP(s):	Project Affected Person(s)
p0:	Initial Serviceability Index
PC:	Pre-stressed Concrete
P/C:	Provincial/Collector
PCDG:	Pre-stressed Concrete Deck Girder
PCU:	Passenger Car Unit
PDRD:	Provincial Department of Rural Development
PK:	Kilometer Post
PMAC:	Provincial Mine Action Committee
PMU:	Project Management Unit
PO:	Project Owner
PR:	Provincial Road
Pre-FS:	Pre-Feasibility Study
PR/R:	Progress Report
PRW:	Provisional Road Width
PRRO:	Provincial Rural Road Office
PSI:	Present Serviceability Index

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pt:	Terminal Serviceability Index
PWRC:	Public Works Research Center
Q:	River Discharge
RAP:	Resettlement Action Plan
RB:	Road Board
RC:	Reinforced Concrete
RC Slab:	Reinforced Concrete Slab Bridge
RCDG:	Reinforced Concrete Deck Girder
RCBC:	Reinforced Concrete Box Culvert
RCC:	Road Construction Center
RCPC:	Reinforced Concrete Pipe Culvert
RD:	Road Density
TDI:	Road Density Index
RGC:	Royal Government of Cambodia
RMS:	Root Mean Square
ROW:	Right of Way
SC:	Steering Committee
SCF:	Standard Conversion Factor
SME:	Small and Medium Enterprise
SN:	Structural Number
STTC:	Saving in Travel Time Cost
SVRC:	Saving in Vehicle Running Cost
SVFC:	Saving in Vehicle Fixed Cost
T/A:	Technical Assistance
T/T Report:	Technology Transfer Report
UNDP:	United Nations Development Program
UNESCAP:	United Nations Economic and Social Commission for Asia and the Pacific
UNTAC:	United Nations Transitional Authority in Cambodia
TTC:	Travel Time Cost
UTM:	Universal Transverse Mercator
UXO(s):	Unexploded Ordnance(s)
VCR:	Traffic Volume/Capacity Ratio
VOC:	Vehicle Operating Cost
VPD:	Vehicles per Day
W/:	With
W/O:	Without
WB:	World Bank
WGS:	World Geodetic System

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#### [PART A: INFRASTRUCTURE DEVELOPMENT OF ROAD NETWORK]

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## **(2) PRE FEASIBILITY STUDY ON THE HIGH PRIORITY PROJECT**

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# **MASTER PLAN STUDY FOR ROAD NETWORK DEVELOPMENT**

# **PART A**

## **INFRASTRUCTURE DEVELOPMENT OF ROAD NETWORK**

## **CHAPTER A-1 INTRODUCTION**

### **1.1 Background of the Study**

The transportation system in Cambodia is constituted of a road network, a railway and an inland waterway. The road network forms the major part of the transportation system. The length of the road network is 30,258 km in total and, 1-Digit and 2-Digit roads, which form the national road network in the country, are 2,052 km and 2,643 km in length respectively.

Most of these roads, however, were constructed between 1920 and 1930 and have been damaged in the civil war which has continued over the 30-year period since 1970. Furthermore, the roads have been damaged due to overloading with heavy traffic and periodical floods, which has resulted in the current serious condition of the road network system in Cambodia.

Plans to restore 1-Digit roads of 2,052 km long have been almost achieved owing to the bilateral assistance of donors including Japan and international funding agencies. However, plans to restore most of the 2-Digit roads have not yet been formulated and these roads still require rehabilitation and reconstruction.

Due to the limited self-funding ability of Cambodia and the fact that the donor funds are insufficient for nationwide road development and maintenance, the Cambodian government has to push forward with road development taking into consideration their limited technology and institutional and financial situation. The establishment of a realistic and efficient nationwide road network development plan is required as a priority of project.

Under the current situation, in response to the Royal Government of Cambodia, the Government of Japan decided to conduct the Study on the Road Network Development in the Kingdom of Cambodia and has entrusted its execution to the Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of technical cooperation programs for the Government of Japan.

In March 2005, JICA dispatched the Study Team to undertake the Study on the Road Network Development in the Kingdom of Cambodia in accordance with the agreement and scope of works mutually agreed between both governments.

### **1.2 Objectives of the Study**

The major objectives of the Study are:

- 1) To formulate a road development master plan covering the whole country of Cambodia with a target year of 2020, including the study of the institutional development of road maintenance;
- 2) To carry out a pre-feasibility study for selected high priority projects; and
- 3) To undertake a transfer of knowledge and technology.



### 1.3 Study Area

The study area covers the entire territory of Cambodia and the surrounding countries: Vietnam, Thailand and Laos. The roads targeted in the Study are 1-Digit to 2-Digit national roads and provincial roads under the jurisdiction of the MPWT, and local roads in rural areas under the jurisdiction of the MRD.

### 1.4 Work Schedule for the Study

The Study covers a time period of approximately nineteen (19) months, commencing in March 2005 and ending in September 2006. The Study is divided into two phases, namely Phase 1: Master Plan Study and Phase 2: Pre-feasibility Study as shown in **Figure 1.4.1** below:

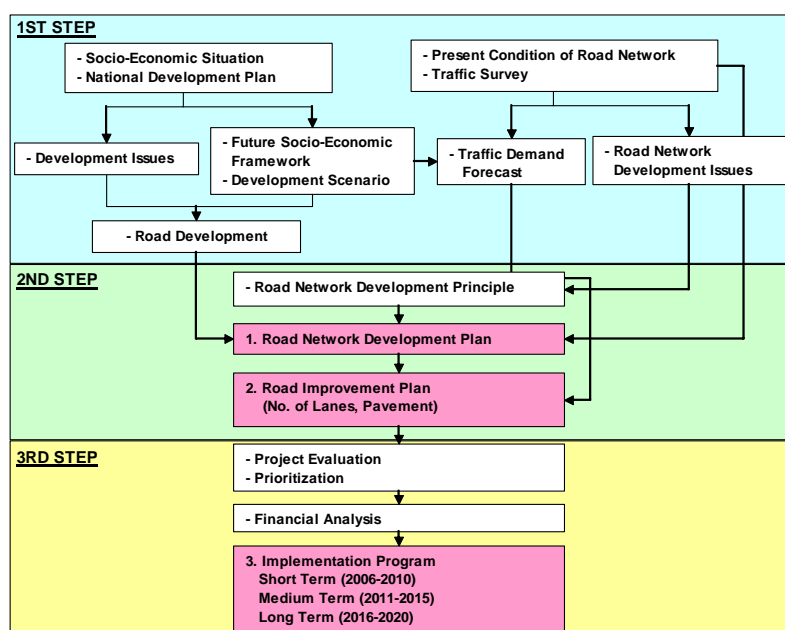
	2005												2006						
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Study Category	← Master Plan												← Pre-F/S →						
Study in Cambodia	█												█						
Study in Japan	□																		□
Report	△ IC/R						△ P/R	△ (Strategy for Road Network Development)		△ (M/P)			△ IT/R				△ DF/R		△ F/R
Steering Committee	△ 1st S/C						△ 2nd S/C	△ 3rd S/C		△ 4th S/C			△ 5th S/C				△ 6th S/C		
Seminar							▲						▲				▲		

**Figure 1.4.1 Overall Work Schedule**

The work flow diagram, illustrating the inter-relationship between the study activities, is presented in **Figure 1.4.2**.

### 1.5 METHODOLOGY

The study has been conducted to propose those plans which are likely to be realized on the basis of in-depth analysis on present issues and proposals of improvement. The total flow of the Study is shown in the following **Figure 1.5.1**.



**Figure 1.5.1 Formulation Flow of M/P**

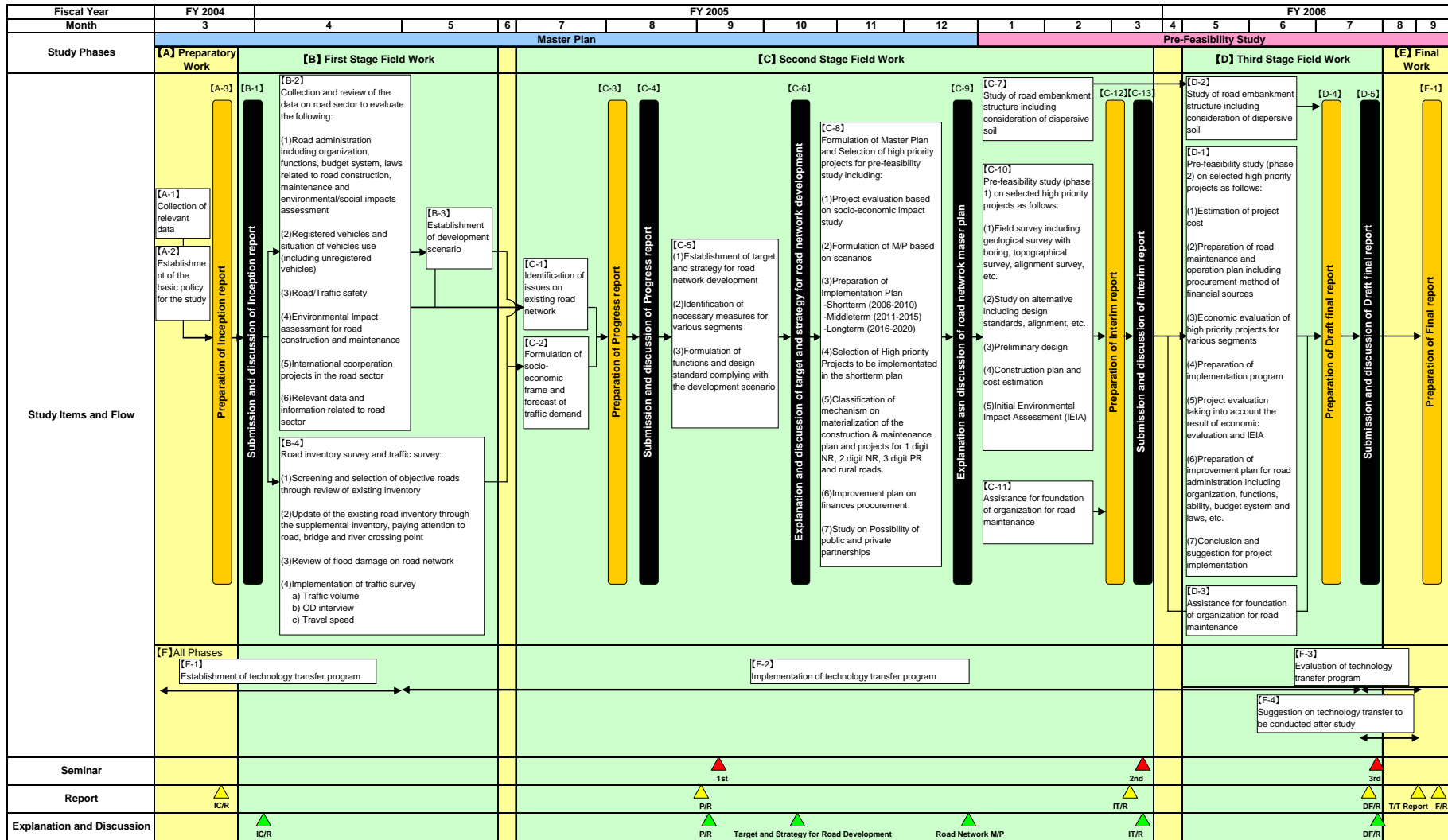
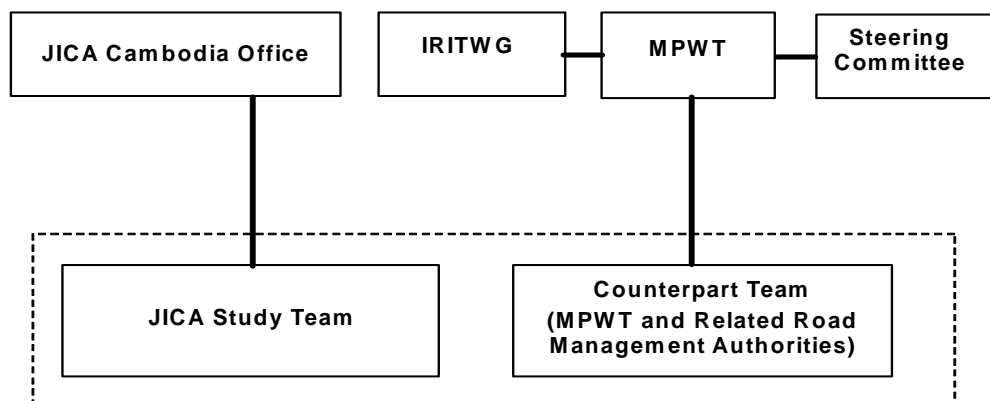


Figure 1.4.2 Study Flow

## 1.6 Organization of the Study Team

The Study is conducted by the organization shown below:



### (1) Study Team

The JICA Study Team includes the following members:

Mr. Hiroki SHINKAI	Team Leader
Mr. Takashi SHIMIZU	Deputy Leader / Road Planning 1
Mr. Akihisa KOJIMA	Deputy Leader / Development Strategy / Donor Coordination
Ms. Mika MATSUMURA	Regional Development / Capacity Development
Mr. Kazuo YUMITA	Administration, Organization and Institution Management
Mr. Takao FUKUMA	Road Maintenance Management
Mr. Katsuyoshi MATSUDA	Financial Analysis and Procurement
Mr. Hisatoshi NAITO	Road Conditions Survey 1
Mr. Futoshi MITSUHATA	Traffic Survey
Mr. Shuichi YASHIRO	Transport Planning 1 / Traffic Demand Forecast
Mr. Tatsuya MASUZAWA	Transport Planning 2 / Railway & Inland Waterway
Mr. Masahiro IBAYASHI	Environmental and Social Consideration
Ms. Kol LEAKHANA	Public Consultation
Mr. Keiichi SAKAEBARA	Natural Environment / Hydrology & Hydraulics
Mr. Jovito C. SANTOS	Road Facility Structural Planning
Mr. Shigeru. TAKARA	Road Facility Design / Construction Plan / Cost Estimation
Mr. Toshio KIMURA	Project Evaluation
Mr. Ippei IWAMOTO	Administration / Road Condition Survey 2
Mr. Yutaka KOBAYASHI	Soil Survey / Road Embankment Survey
Mr. Norihiro TSUNOKUNI	Soil Survey / Road Embankment Survey
Mr. Naresh STHAPIT	Road Planning 2 / Road Design

**(2) Steering Committee**

The Kingdom of Cambodia has established a Steering Committee consisting of the following organizations under the chairmanship of the Ministry of Public Works and Transport for the smooth implementation of the Study:

Ministry of Public Works and Transport (MPWT)

Ministry of Rural Development (MRD)

Ministry of Water Resources and Meteorology (MOWRAM)

Ministry of Environment (MOE)

Ministry of Economy and Finance (MEF)

Ministry of Land Management, Urban Planning and Construction (MLMUPC)

Ministry of Planning (MOP)

Council for the Development of Cambodia (CDC)

In carrying out the Study, the Study Team has worked with the counterpart personnel assigned by the counterpart agencies.

## CHAPTER A-2 NATURAL CONDITIONS AND SOCIO-ECONOMIC PROFILE

### 2.1 Natural Conditions

#### 2.1.1 Topography of Cambodia

Cambodia covers an area of 181,035 square kilometers in the southwestern part of the Indochina peninsula. It borders Vietnam to the east and the southeast, Laos to the north, and Thailand to the north and the west. The lengths of these shared borders are 1,228 km, 541 km and 800 km respectively. It also has a coastline of 435 km on the Gulf of Thailand to the southwest.

Dominant geographical features of Cambodia are the existence of the great lake, Tonle Sap and the longest river in south-east Asia, the Mekong. The Mekong River flows southward from the Cambodia-Laos border, passing the major cities of Stoeng Treng, Kracheh, Kampong Cham and Phnom Penh, and runs into Vietnam.

Cambodia has three topographic regions as shown in **Figure 2.1.1**, those are Central Plain Region, Mountainous Region and Coastal Region. The proportions of these regions of the total area are about 51%, 39% and 10% respectively.

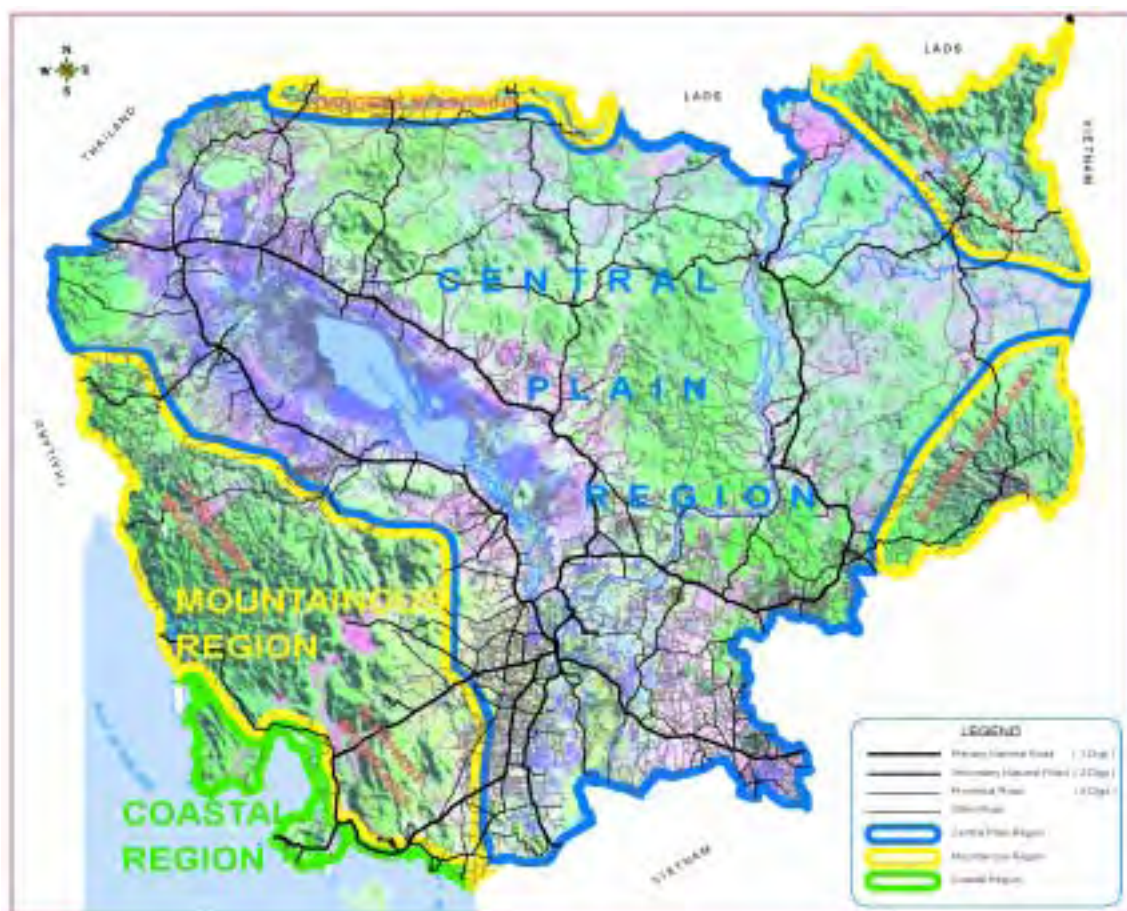


Figure 2.1.1 Topography of Cambodia

The Central Plain Region, including Tonle Sap and the Mekong River, is the largest part of the land. It consists of the alluvial ground mainly made by Tonle Sap and the Mekong River with elevations generally of less than 100 meters. As the elevation increases, the terrain becomes more rolling and dissected. Since the rich sediment, deposited during the Mekong River's annual flood season, made the agricultural lands highly fertile, the population is concentrated in this region.

The Mountainous Region, located generally at the rims of Central Plain Region, includes the Dangrek Mountains, Cardamom Mountains, Elephant Mountains, and Eastern Highlands. The Dangrek Mountains, located to the north of the Central Plain, consist of a steep escarpment with an average elevation of about 500 meters, the highest points of which reach more than 700 meters. The Dangrek Mountains adjoin the southern edge of the Koral Plateau in Thailand, and the watershed along the escarpment marks the boundary between Thailand and Cambodia. The main road through a pass in the Dangrek Mountains at O Smach (NR.68) connects northwestern Cambodia with Thailand. Despite this road and those running through a few other passes, in general the escarpment impedes easy communication between the two countries. Two mountains on the southeast of the plain, the Cardamom Mountains and the Elephant Mountains, cover a large part of the area between Tonle Sap Lake and the Gulf of Thailand. The Cardamom Mountains in the southwest, oriented generally in a northwest-southeast direction, rise to more than 1,500 meters. The highest mountain in Cambodia, Phnom Aural (1,771 meters) is in the eastern part of this range. The Elephant Mountains, an extension running toward the south and the southeast from the Cardamom Mountains, rises to elevations of between 500 and 1,000 meters. These two ranges are bordered on the west by a narrow coastal plain that contains Kampong Saom Bay, which faces the Gulf of Thailand. In addition to those mountains, in the northeast (Ratanak Kiri Province) and east (Mondul Kiri Province), a hilly plateau, called the Eastern Highland extends along the border with Laos and Vietnam.

The Coastal Region, containing parts of four provinces/municipalities (Koh Kong, Sihanoukville, Kampot and Kep), is composed of the southwestern mountains and small strips of lowlands, and the lowlands are densely populated, as is the Central Plain Region. The Coastal Region is always the first to receive heavy rains due to the mountain ranges rising to the southwest of Tonle Sap Lake, and it is one of the wettest regions in Cambodia (mean annual rainfall is more than 2,000mm).

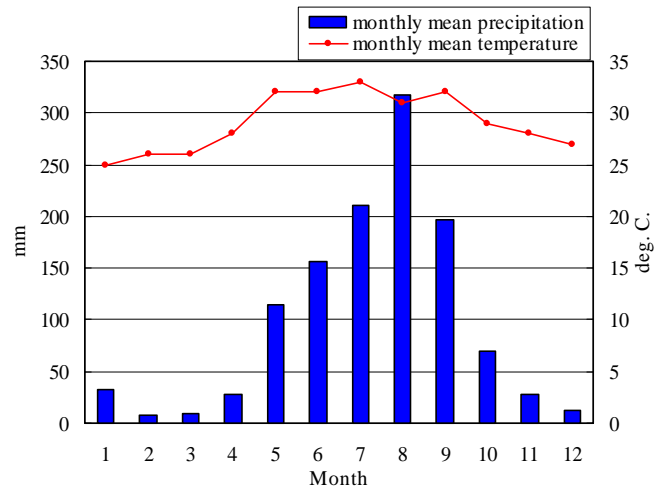
### **2.1.2 Climate of Cambodia**

The Climate of Cambodia is dominated by tropical monsoons because of the distinctly marked seasonal differences. The monsoonal airflows are caused by the annual alternation of high pressure and low pressure over the Central Asian landmass. In summer, moisture is drawn landward from the Indian Ocean. The flow is reversed during the winter, and the northeast monsoon sends back dry air. The southwest monsoon flow of drier and cooler air lasts from early November to March. The southern third of the country has a two-month dry season; the northern two-thirds, a four-month one. Short transitional periods, which are marked by some difference in

humidity, but only a minor change in temperature, intervene between the alternating seasons. Temperatures are fairly uniform throughout the Tonle Sap Basin area, with only small variations from the average annual mean of around 25 . The maximum mean is about 28 ; the minimum mean, about 22 . Maximum temperatures of higher than 32 , however, are common and just before the start of the rainy season, they may rise to more than 38 . Minimum temperatures rarely fall below 10 . Typhoons that often devastate coastal Vietnam rarely cause damage in Cambodia.

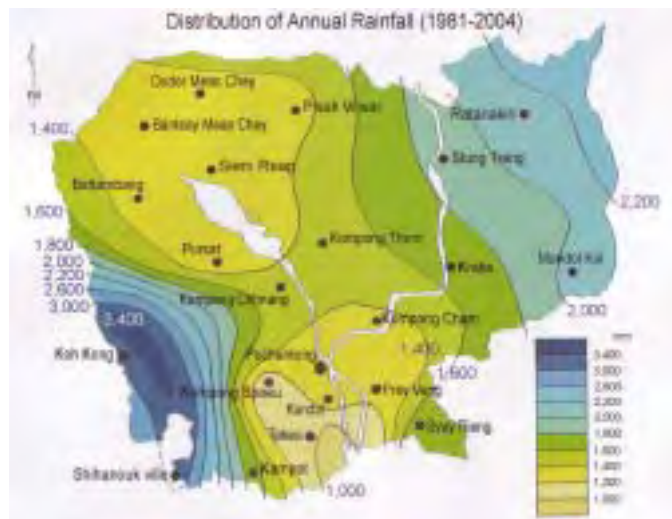
The total annual rainfall average is between 1,000 and 1,500 mm, and the heaviest amounts fall in the southeast. Rainfall from April to September in the Tonle Sap Basin-Mekong Lowlands area averages 1,300 to 1,900 mm annually, however the amount varies considerably from year to year. Rainfall around the basin increases with elevation. It is heaviest in the mountains along the coast in the southwest, which receive from 2,500 to more than 5,000 mm of precipitation annually as the southwest monsoon reaches the coast. This area of greatest rainfall, however, drains mostly to the sea; only a small quantity goes into the rivers flowing into the basin.

Monthly mean temperature and monthly mean precipitation (nation-wide average) are shown in **Figure 2.1.2** and the distribution of annual rainfall is shown in **Figure 2.1.3**.



Source: Cambodia Country Maps

**Figure 2.1.2 Mean Precipitation and Temperature**



Source: Department of Meteorology

**Figure 2.1.3 Distribution of Annual Rainfall**

## 2.2 Socio-Economic Situation

### 2.2.1 Key Indicators of Cambodia and Neighboring Countries

Cambodia is bordered by three countries: Thailand, Laos and Vietnam. The societies of these four countries influence the others countries cultures and socio-economic activities. In particular, the linkage of economic activities including the labor forces and the trades, has become increasingly active in recent years.

The major socio-economic indicators for these four countries are summarized in **Table 2.2.1** below. Cambodia is the second smallest of the four countries with respect to population, land size, and economy, and has the lowest GDP per capita. Cambodia has the lowest daily per capita calorie supply and 46% of children under the age of five suffer from malnutrition. The accessibility of safe water, in both urban and rural areas of Cambodia, is also the lowest of the four countries.

**Table 2.2.1 Socio-Economic Indicators for Cambodia, Thailand, Vietnam and Laos in 2003**

Indicator	Cambodia	Thailand	Vietnam	Laos
<b>POPULATION</b>				
Total population (millions)	13.3	63.96	80.90	5.68
Population density (persons per square kilometer)	73	123	246	25
Annual Population Increase (%)	1.9	0.8	1.5	2.8
<b>EDUCATION (2000)</b>				
Literacy rate, adult female (% of those 15 and above)	57%	94%	91%	53%
Literacy rate, adult male (% of those 15 and above)	80%	97%	94%	76%
<b>HEALTH AND NUTRITION</b>				
Daily per capita calorie supply (calories)	2011	2459	2498	2303
Child malnutrition (% of children under 5)	46%	10%	33%	40%
Population with access to safe water (Urban)	54%	95%	95%	61%
Population with access to safe water (Rural)	26%	81%	72%	29%
<b>LAND</b>				
Surface area ('1000 sq. km)	181	513	332	237
Roads, paved (% of total roads)(by WB)*	16%	99%	25%	45%
* 2000 in Cambodia/Thailand and 1999 in Vietnam / Laos				
<b>NATIONAL ACCOUNTS</b>				
At Current Market Basic Prices (in Billions US Dollar)				
GDP by industrial origin	3.96	150.01	38.71	2.13
Agriculture	1.47	14.64	8.45	1.03
Mining	0.02	3.93	3.65	0.04
Manufacturing	0.76	52.78	8.05	0.41
Electricity, gas, and water	0.02	4.84	1.49	0.06
Construction	0.25	4.42	2.28	0.05
Trade	0.56	23.04	5.33	0.22
Transport and communications	0.26	11.72	1.44	0.13
Finance	0.24	9.42	0.70	0.01
<b>Structure of Output as % of GDP at current prices</b>				
Agriculture	37.2	9.8	21.8	48.6
Industry	26.8	44.0	40.0	25.9
Services	36.0	46	38.2	25.5
<b>Growth of Output annual change, % of GDP</b>				
At Current Market Prices, in Dollar Per Capita GDP	314.5	2345.4	478.4	379.1

Source: ADB, Key Indicators 2003: Education for Global Participation  
World Bank, <http://devdata.worldbank.org/data-query/>



In terms of economy, Cambodia's small scale labor force and land size puts it at an economic disadvantage compared to Thailand and Vietnam. The GDP of Cambodia in the year 2003 was 3.97 billion US Dollars, which was approximately 2.6% of Thailand's GDP that year. While the large consumer markets of Thailand and Vietnam are direct neighbors to Cambodia, the potential of this location has not been fully utilized to sell Cambodian commodities.

Agriculture is a major industry in Cambodia, contributing 37.2% of the GDP in 2003. The growth rate of agricultural products has stagnated since 1999 and has fluctuated due to the unstable climate. Although Cambodia has a greater area of flat land than Laos, productivity has not improved due to the delay in the development of irrigation systems. As shown in the GDP of the agricultural sector in **Table 2.2.2**, it is hard for Cambodia to compete with Thailand and Vietnam particularly in the quantity of agricultural products. The annual yield of the paddy rice in Cambodia is 4,710 thousand metric tons compared to 27,279 thousand metric tons in Thailand and 34,568 thousand metric tons in Vietnam. The traded price and volume of paddy rice, which is the major product of Cambodia, is always influenced by the trade of these neighboring countries. It is said that a certain amount of paddy rice produced in Cambodia has been transported to Thailand and Vietnam not only for their consumption but also for export to Africa and other countries. However, the real statistics for the trading business of paddy rice is still unclear. As most of the heavy trucks passing through the Cambodian road network from rural areas to international borders are loaded with agricultural products, agro-business trend should be considered in relation to road network design and maintenance.

**Table 2.2.2 Agricultural Production in 2003 (1000 metric tons)**

Item	Cambodia	Thailand	Vietnam	Laos
PRODUCTION				
Rice (paddy)	4,710	27,279	34,568	2,500
Maize	314	4,185	3,136	112
Rubber	107	2,506	363	
Logs, '000 cu. m.	664			
Fish	345			

Source: ADB, Key Indicators 2003: Education for Global Participation

**Table 2.2.3** describes the external trade of the four countries in 2003. Thailand leads in terms of external trade and is followed by Vietnam, both in external trade and in GDP. Cambodia's volume of exports was 1,917 million US dollars and import volume was 2,469 million US dollars in 2003. The trade balance shows that three countries out of the four have a trade gap deficit, with Cambodia's deficit being -552 million US dollars.

**Table 2.2.3 External Trade in 2003 (Million US dollars)**

Item	Cambodia	Thailand	Vietnam	Laos
EXTERNAL TRADE				
Exports, fob	1,917	84,210	20,176	366
Imports, fob	2,469	79,263	25,227	501
Trade balance	-552	4,947	-5,051	-136

Source: ADB, Key Indicators 2003: Education for Global Participation

As stated in **Table 2.2.4**, the United States is the biggest contributor to Cambodian international trade. Cambodia achieved the Generalized System of Preferences (GSP) and Most Favored Nation (MFN) status from the major trading partners in 1997. In particular, clothing exports were fostered through a US-Cambodian Bilateral Textile Agreement signed in 1999. This agreement gave Cambodia a guaranteed quota of US textile imports and established a bonus system for improving working conditions and enforcing Cambodian labor laws and international labor standards in the industry. With the January 2005 expiration of the WTO Agreement on Textiles and Clothing, Cambodia-based textile producers are now facing direct competition from lower-priced producers in countries such as China and India<sup>1</sup>. However, the results of a survey conducted by the Ministry of Commerce indicate that the impact of the expiration on the textiles industry has so far not been as serious as expected. It appears that the reason the factories have not been losing business to the competition is that clients appreciate their compliance with the labor laws. As the textile factories are located in Phnom Pen, the commodities are transported along NR.4 to Sihanukvill to reload at the port. As far as the GMS countries are concerned, Thailand and Vietnam are important business partners of Cambodia. Thailand rates tenth in terms of exports and first in terms of imports. The major method of transportation is by road in both countries however the waterways have been emerging as the alternative. Vietnam is rated fifth in terms of both exports and imports. Most of the commodities are transported to and from Vietnam through the inland waterways of the Mekong River due to the inconvenient loading system in the inland office for customs and inspections.

**Table 2.2.4 Trading Partners (Year 2003)**

(unit: Million US \$)

	Exports			Imports		
	total	2,031.8	100%	total	2,802.4	100%
1	US	1,214.3	59.8%	<b>Thailand</b>	756.5	27.0%
2	Germany	211.3	10.4%	Hong Kong	411.2	14.7%
3	UK	150.3	7.4%	Singapore	338.2	12.1%
4	Japan	80.1	3.9%	China	324.1	11.6%
5	Singapore	67.8	3.3%	Korea	144.6	5.2%
6	France	40.5	2.0%	<b>Vietnam</b>	135.5	4.8%
7	<b>Vietnam</b>	30.3	1.5%	Indonesia	84.5	3.0%
8	Netherlands	25.6	1.3%	Malaysia	68.9	2.5%
9	China	23.6	1.2%	Japan	67.3	2.4%
10	<b>Thailand</b>	11.3	0.6%	France	53.6	1.9%

Source: ADB, Key Indicators 2003: Education for Global Participation

## 2.2.2 Recent Socio-Economic Trends of Cambodia

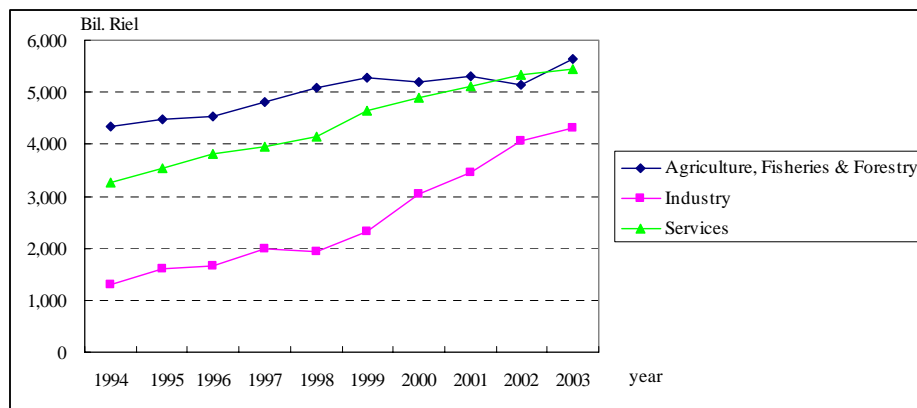
### (1) Stability of Social Environment and Macro Economic Growth

The Paris Peace Accord was signed in 1991 after the Vietnamese troops withdrew from Cambodia. The United Nations Transitional Authority in Cambodia (UNTAC) was installed two years later. King Sihanouk became the constitutional monarch of the new government during the first free elections in 21 years.

<sup>1</sup> <http://www.nationmaster.com/country/cb/Economy>

Although there have been disputes, such as the military conflict in 1997 between the Khmer Rouge and the new government established by national election, they have not caused serious social disruption of the Cambodian nation as a whole. The restoration and development of Cambodian society, including communes and villages, have therefore progressed relatively smoothly with the assistance of international donors, although the poverty-stricken areas still face problems.

As civil order has been sustained, the economy has grown as well. **Figure 2.2.1** indicates the growth in GDP in constant year 2000 prices.



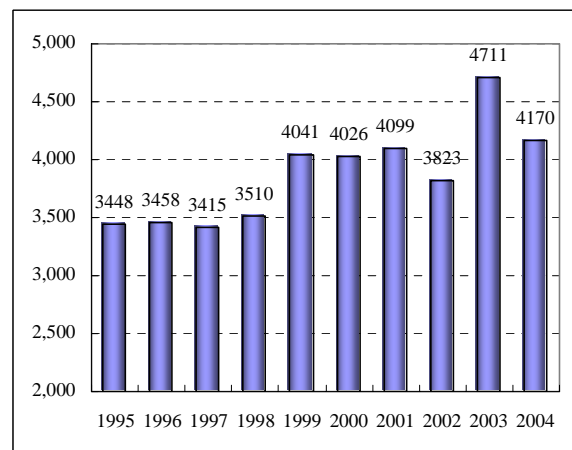
Source: National Institute of Statistics

**Figure 2.2.1 GDP Economic Growth by Sectors in Constant Price 2000**

**(2) Agriculture Sector**

1) Stagnation of paddy production

Agriculture is the leading industry in Cambodia in terms of both GDP and population engaged. According to the data processed by the National Institution of Statistics, agriculture contributes towards 34.7% of the GDP. That is 5,637,960 million riel at current pricing levels. The GDP growth rate for the agricultural sector has fluctuated mainly due to climate changes, but it has averaged out at approximately 3% in the last 10 years.



Source: MAFF

**Figure 2.2.2 Paddy Production (1000 ton)**

The ratio of households engaged in crop production, including landless farmers, is 84.79% according to Ministry of Agriculture, Fisheries and Forestry. Although the proportion that the agriculture sector forms of the GDP is decreasing year by year, the agriculture sector is still very important from the viewpoint of the farming population in the capacity of labor

absorption.

After reaching self-sufficiency in terms of rice production in 1995, the Government considered whether paddy and/or rice would be potential commodities for export. However, since that time paddy production has fluctuated depending on the climate as shown in **Figure 2.2.2**. The Government has recommended that farmers change the bread variety from the local variety to a hybrid variety that is high yield however few farmers have changed varieties as the hybrid is weaker in drought conditions and has a less desirable taste.

## 2) Food security and domestic transportation

**Figure 2.2.3** illustrates the food balance of paddy by province in 2004. The surplus converted into rice for Takeo, Prey Veng and Battambang was 222,092 tons, 137,522 tons and 115,956 tons respectively. In 2004, the total rice surplus for Cambodia was 416,118 tons.

The yield in southeast areas such as Takeo, Kandal and Prey Veng was better due to the better-managed irrigation systems for double-cropping and the introduced hybrid varieties. Most of the hybrid paddy is exported to Vietnam through the waterways and through inland routes when the international price increases. Local brands are mainly consumed by farmers and consumers in Phnom Penh.

The provinces along Tangle Sap Lake, such as Battambang and Kampong Chhnang, are also large production areas and have a surplus of paddy. In the colonial period the paddy was transported by railway, however the road networks, including the rural feeder roads, provincial roads and national roads, are now used for the transportation of paddy. The surplus in these areas goes to Thailand and Phnom Penh to meet their demands. The potential of the agriculture industry is high in these areas; however, there are constraints in terms of irrigation and road conditions. The un-paved roads linking the farming areas with the markets are easily damaged by heavy trucks loaded with paddy, in particular during the harvest seasons.

Paddy/rice is a major product for transport. If the Government promotes the paddy/rice industry, the roads linking potential production areas should be taken into consideration.



In terms of maize, newly established factories along the border of Thailand in Pursat Province have started exporting livestock feeds to Thailand. Potential horticultural products are also being considered near the Thailand border.

#### 4) Forestry and Logging

Although forestry was productive and logging was one of the major export goods in the early 1990s, the volume of production has declined from 756,294 million Riel in 1994 to 315,894 million Riel in 2003 (in GDP at a constant price). Illegal logging has not been eradicated and the transport of heavy timbers has caused road damage. It is said that the development of roads in rural areas may cause an increase in illegal logging. The environment also has to be taken into consideration in terms of the road networks.

### (3) Manufacturing Sector Lead by Textile Industries

#### 1) Rapid growth of manufacturing sector

The industrial sector accounted for 26.6% of the GDP in 2003; however, the growth of this sector has been very rapid. The manufacturing, textile and construction industries are doing well.

**Table 2.2.5 Production of Manufacturing Sector (Constant Price 2000)**

(unit: Billion Riel)

	1995	2000	2001	2002	2003
Mining	27.7	33.5	38.0	45.2	48.3
Manufacturing	967.1	2228.3	2556.8	2943.7	3242.7
Food, Beverages & Tobacco	395.4	433.4	452.9	444.0	461.8
Textile, Wearing Apparel & Footwear	139.6	1285.4	1590.1	1924.7	2190.0
Wood, Paper & Publishing	218.3	109.9	74.8	84.8	88.0
Rubber Manufacturing	24.7	69.2	69.7	69.2	65.8
Other Manufacturing	189.2	330.5	369.3	421.0	437.1
Electricity, Gas & Water	37.9	46.1	46.7	47.9	50.3
Construction	557.9	731.6	801.8	1016.9	979.8
	2,557.7	5,267.8	6,000.1	6,997.4	7,563.8

Source: National Institute of Statistics

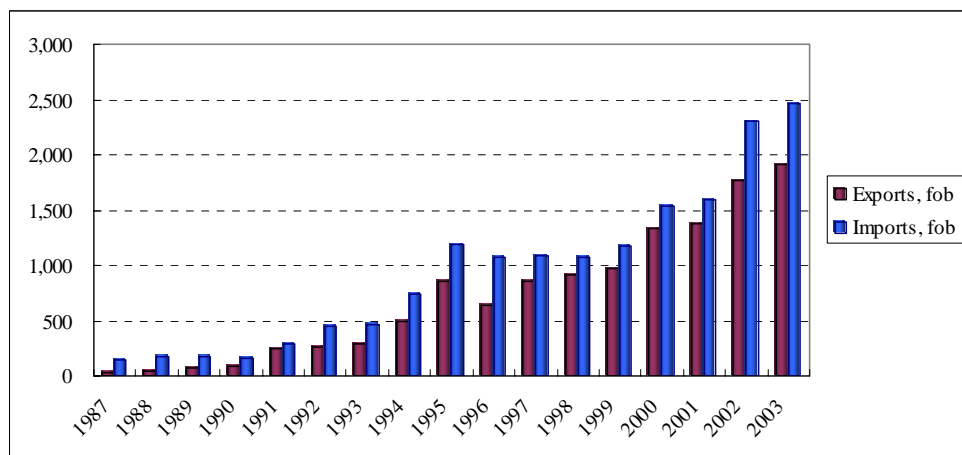
#### 2) Export of Textile

**Figure 2.2.4** illustrates the trend in Cambodian exports and imports in million US dollars. Although the volume of trade dropped off in 1997, due to the political disorder influenced by the election and the economic crisis of the Asian countries, international trade has been growing since the GSP and MFN agreement in 1997.

As mentioned above, external trade has increased rapidly since 1999 and the US-Cambodian Bilateral Textile Agreement under the concept of the GSP and MFN. The foreign private investors from China, Malaysia and Taiwan have established a total of 250 textile factories, and

employ 300,000 local workers accounting for approximately 5% of the total workforce <sup>2</sup>.

At the same time, the government encouraged the development of the industrial zone along the ocean in Shianokvill and Kep. Although the coastal area near the ports is a better site from a cost perspective due to security reasons, most factories had already been established in the capital city. It is expected that new investors will establish factories in the newly developed zones.



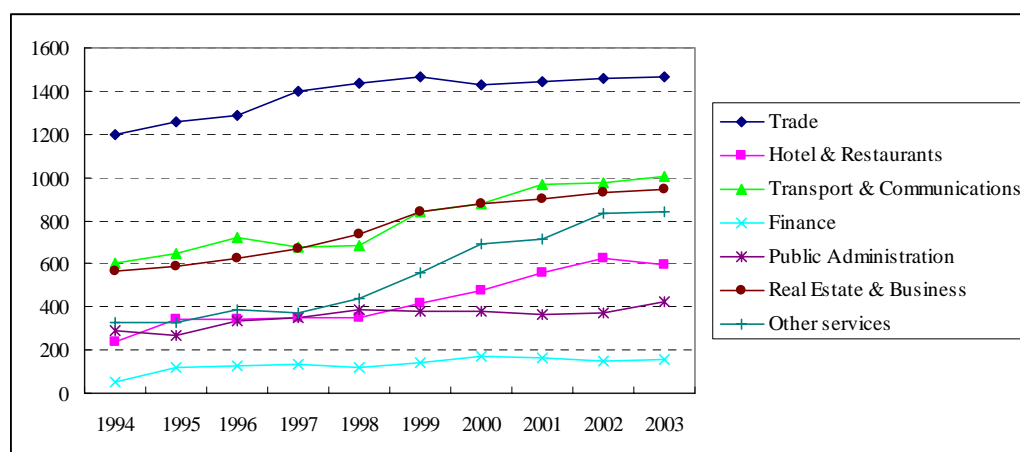
Source: ADB

**Figure 2.2.4 Tendency of Cambodian International Trade**

#### (4) Service Sector

The service sector is the second largest sector in Cambodia and this sector has been steadily growing, as shown in **Figure 2.2.5**.

Trade is largest industry in this sector, followed by Transport & Communications. The growth of the Hotel & Restaurants sub-sector has been rapid since 2000.



Source: National Institute of Statistics

**Figure 2.2.5 Growth of Service Sector by Sub-sectors**

<sup>2</sup> Ministry of Commerce, “Cambodia Economic Watch, April 2005 ” Economic Institute of Cambodia

The total number of visitor arrivals to Cambodia reached one million in 2004, including 67,843 visitors through Preah Vihear, which was not registered until 2003. As shown in **Table 2.2.6**, the number of visitors has been increasing year by year, in particular the visitors by direct flight to Siem Riap where Angkor Wat is located. The number of visitors from Korea is 128,423 (12.17%), followed by the Japanese with 118,157 visitors (11.20%). A sharp rise in the number of visitors by land and boat was observed in 2004. The escalation in the number of visitors by land and boat might have been caused by the better security at the borders between the neighboring countries; Thailand, Vietnam and Laos.

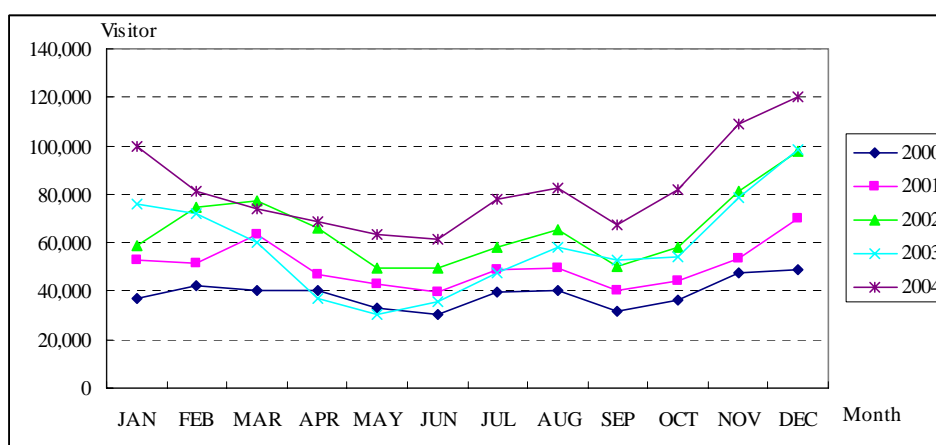
**Table 2.2.6 Visitor Arrivals to Cambodia in 1998-2004 by All Means of Transport**

	1998	1999	2000	2001	2002	2003	2004
Phnom Penh Flight	175,910	234,382	264,649	274,689	320,187	269,674	316,748
Siem Reap Direct Flight	10,423	28,525	87,012	133,688	202,791	186,298	309,373
By Land & Boat	100,191	104,836	114,704	196,542	263,546	245,042	*429,081
Grand Total	286,524	367,743	466,365	604,919	786,524	701,014	1,055,202

Source: Ministry of Tourism  
\* including Preah Vihear

The number of visitors fluctuates in accordance with the weather and the world vacation trend. As seen in **Figure 2.2.6**, there are a relatively high number of visitors during the dry season in the period from November until April due to the better road conditions. There are fewer visitors during the wet season in the period from May until October, except during the international summer season in July and August.

In terms of industry, the wet season is less active not only in the agricultural sector but also in the service sector. This may affect the volume of inland traffic, however there is no statistical data covering a full year.



Source: Ministry of Tourism

**Figure 2.2.6 Number of Visitors by Month**



## CHAPTER A-3 TRANSPORT SECTOR IN CAMBODIA

### 3.1 Characteristics of the Railway and Inland Waterways in Cambodia

The modes of transport in Cambodia consist of the road network, railway, inland waterways and air transport. Road transport has an overwhelming share of the total volume of passengers and freight, and the other means of transport play a supplementary role to road transport as shown in **Table 3.1.1**. Although this Study will establish a road development plan which is cohesive with the development of transport modes other than road transport, air transport will be excluded from this study as there are only two regular flight services (two flights per day between Phnom Penh and Siem Reap and four flights per week between Phnom Penh and Ratanakili), and air transport plays an extremely limited role.

**Table 3.1.1 Passenger and Cargo Volume by Mode of Transport**

Mode of Transport	Person-km/year (million)	Ton-km/year (million)
Roads	146.8 (65%)	274.0 (69%)
Railway	45.0 (20%)	41.0 (10%)
Inland Waterway	35.0 (15%)	80.0 (20%)
Total	226.8 (100%)	395.0 (100%)

Both the railway and inland waterways have higher energy consumption efficiencies per unit of transported volume than road transport and are superior in terms of long-distance mass volume transit. The railway in Cambodia consists of two lines: the north line connecting the capital city, Phnom Penh, and Poipet on the border with Thailand; and the south line connecting Phnom Penh with Sihanoukville where the country's sole deep port is located. With regard to inland waterways, the mainstream of the Mekong River, Basak River and Tonle Sap River form the waterway network. These railway and inland waterway networks connect Cambodia's key centers and it is expected that the organic linkage with the road network, as the leading mode of land transport, will achieve an efficient transportation network. **Figure 3.1.1** shows the highways, railway, inland waterways and the major connecting points of these transit methods.

This Study investigates the present status of the railway and inland waterways and, at the same time, clarifies the complementary roles for road transport. The results of this Study will be reflected in the plan for the development of the road network.

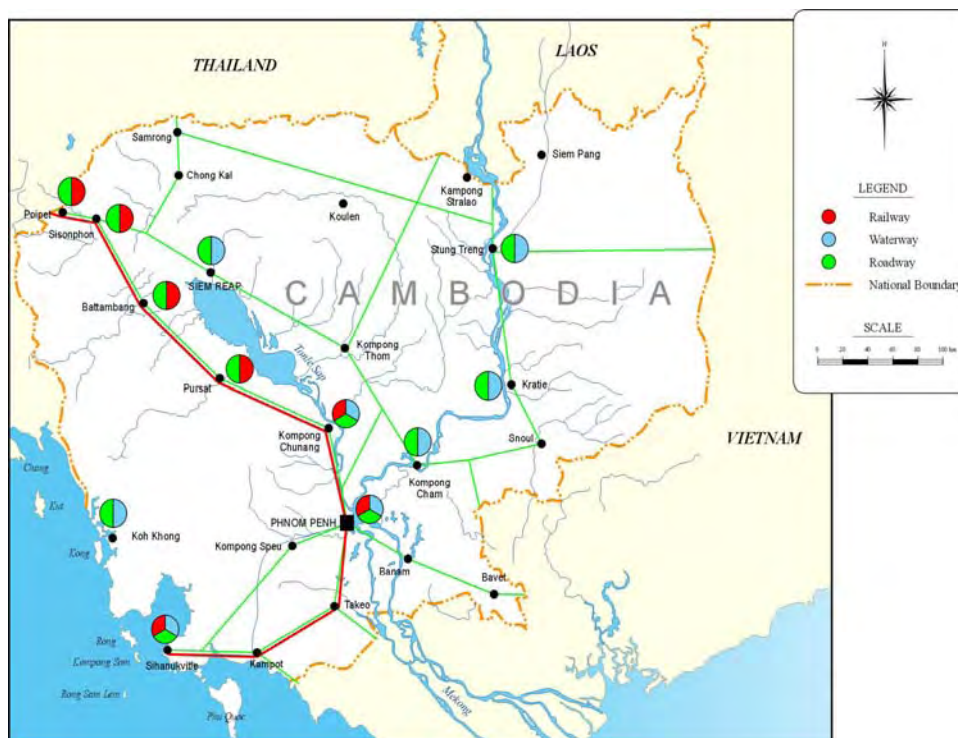


Figure 3.1.1 Railway/inland waterway network and major connecting points

## 3.2 The Present Status and Expected Role of the Railway

### 3.2.1 Present Status of the Railway

The railway route in Cambodia currently consists of two lines with a total length of 639 km. The North line is 385 km in length and connects the capital city, Phnom Penh, and Poipet on the border with Thailand. The South line is 263 km in length and connects Phnom Penh and Sihanoukville, where the sole deep port is located. The construction of the North and South lines was completed in 1943 and 1969 respectively. The civil war, which commenced in 1970, caused significant deterioration to the railway infrastructure. In particular, a 48 km-long section on the North line between Sisophon and Poipet is now impassable as the track is missing due to the looting that occurred during the civil war.

The entire length of the North and South lines are single-track and non-electrified. The gauge that has been adopted is the so-called “Indochina gauge”. This consists of the same 1000 mm gauge as the railway lines in Indochinese countries (e.g. Malaysia, Thailand and Vietnam), and consequently as the same gauge is used it is possible for a through service to be provided to neighboring countries (Thailand and Vietnam) in the future.

The Royal Railway of Cambodia (RRC) operates only one round-trip passenger train on the North line consisting of a mixed train running between Phnom Penh and Battambang every two

days. The RRC does not provide a passenger service on the South line or the northern section (from Battambang) of the North line. For freight trains, there is no fixed train diagram. When a shipper makes a request, a dispatcher and stationmaster decide the operation time after due consultation and arrange a locomotive engine and crewmen to provide the freight train service. The main business of the RRC is freight transport. The passenger services make up only 2.6% of the RRC's income, and this indicates that the passenger trains are rendered only as a public service.

**Table 3.2.1** shows the performance of the Royal Railway of Cambodia.

**Table 3.2.1 Transportation Performance by lines and items (traffic tonnage) (2001-2003)**

line	item	2001		2002		2003	
		Traffic tonnage	%	Traffic tonnage	%	Traffic tonnage	%
North Line	Petroleum Products	27,200	13.5	23,500	6.6	18,900	15.5
	Cement	78,500	39.0	230,600	65.2	43,700	35.7
	Rice	44,800	22.3	44,200	12.5	9,500	7.7
	Others	37,950	18.8	42,700	12.1	5,000	4.1
	Container	0	0	0	0	0	0
	Internal Operation	12,900	6.4	12,700	3.6	45,400	37.1
	Total	201,500	100	353,700	100	122,500	100
South Line	Petroleum Products	35,100	16.9	80,800	39.7	114,900	38.2
	Cement	156,600	75.2	97,000	47.6	175,700	58.4
	Rice	8,400	4.0	11,000	5.4	2,000	0.7
	Others	400	0.2	200	0.1	200	
	Container	0	0	0	0	0	0
	Internal Operation	7,800	3.7	14,700	7.2	8,000	2.7
	Total	208,300	100	203,700	100	300,700	100
Total of North & South		409,700		557,300		423,200	

The main items transported on the North and South lines are cement and petroleum products. The RRC does not transport containers at all even though container transport is becoming the mainstream of freight transportation in international trends. Container transport is a potential market for the RRC, and it can be said that container transport is a major objective in the future marketing of the RRC.

Since 1994, the rehabilitation of the railway infrastructure and rolling stock has been partially executed by the MPWT using an ADB loan. The scope of the rehabilitation, however, has been very limited and the RRC still requires significant rehabilitation works to ensure safe and reliable train operation. The MPWT has a 5-year development plan for the railway system for the period from 2004 to 2008, which includes the following projects.

- 1) Urgent restoration of 284 km of railway between Phnom Penh and Sihanoukville.
- 2) Reconstruction of 48 km of railway between Sisophon and Poipet and rehabilitation of 338 km of railway between Phnom Penh and Sisophon.
- 3) Rehabilitation and maintenance of locomotives, freight wagons and tracks.
- 4) Improvement of the signaling and communication system and capacity building of the operations and maintenance staff.
- 5) Preparation of a master plan for the railway improvement.
- 6) A feasibility study for a new railway linking Phnom Penh and Ho Chi Minh City (Batdoen – Loc Ninh : 255 km)

### **3.2.2 Expected Role of the Railway**

The restoration of the so-called “Missing Link” on the North line, in the area near to the border with Thailand, will create a direct linkage between the railway network of Thailand and Phnom Penh. The South line will link Phnom Penh with the port of Sihanoukville, the sole deep sea port in Cambodia. Both lines are major transportation routes that support the Cambodian economy and it is expected that the railway will play a certain role in future freight transportation.

In road transportation, the increase in the number of heavy vehicles causes the following problems;

- 1) Escalation of maintenance costs due to the increased pavement damage,
- 2) Worsening of traffic congestion in suburban areas,
- 3) Increase in the number of traffic accidents (especially serious accidents),
- 4) Increase in the level of negative environmental impacts (noise, air pollution by exhaust gas/dust and vibrations) along highways.

The heavy vehicles, such as trucks and trailers that transport freight, are implicated as a cause of the above problems. If some of the freight and dangerous materials can be transported by railway, the above problems can certainly be eased. In particular, the efficient use of the North line and the South line will reduce the traffic on NR.5 and NR.4 respectively.

It is expected that the Cambodian railway will provide a long-distance inter-regional mass

transport system for freight consisting of heavy goods and dangerous materials.

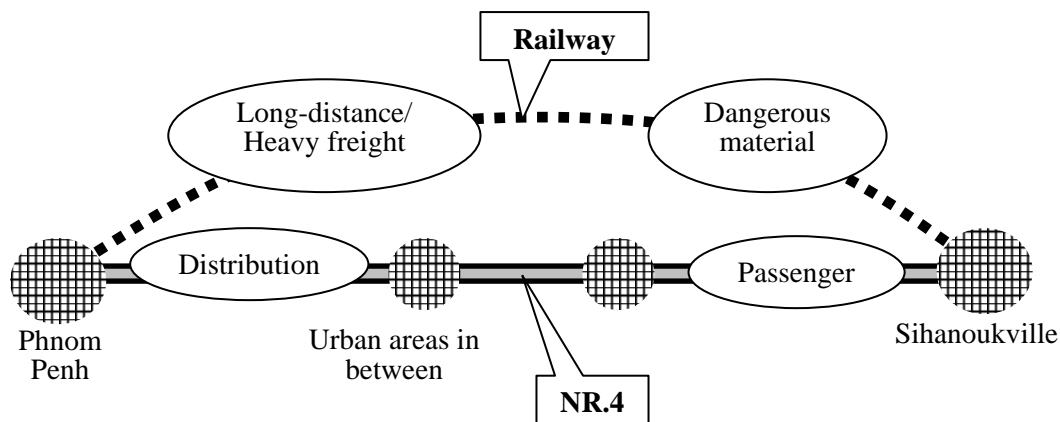


Figure 3.2.1 Share of Land Transport by Road and Railway

### 3.3 The Present Status and Expected Role of the Inland Waterways

#### 3.3.1 Present Status of the Inland Waterways

The inland waterway network in Cambodia consists of the mainstream of the Mekong River, the Barzac River and the Tonle Sap River. The total length of this waterway network is 1,750 km in the rainy season. However, in dry season the water level is lower and only 580 km can be navigated. Figure 3.3.1 shows the navigable size of vessels for the Mekong system in the rainy and dry seasons.

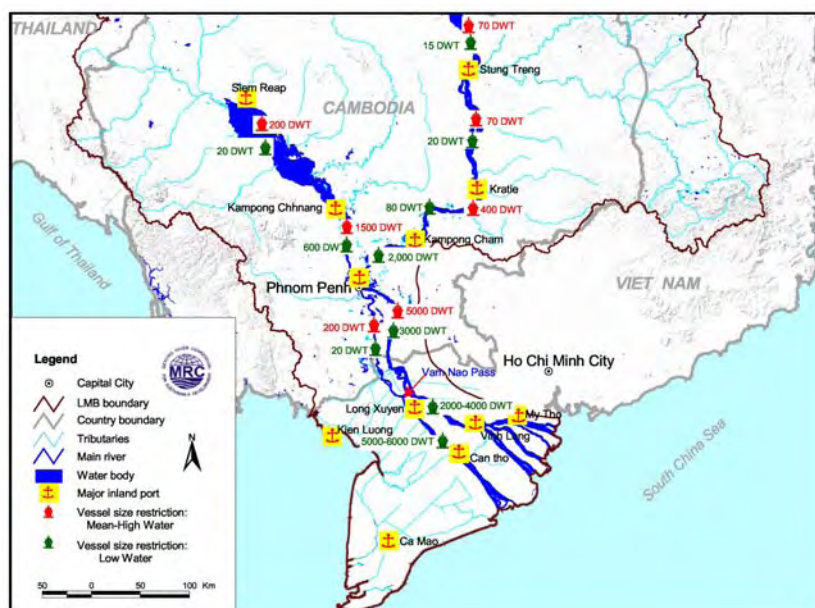


Figure 3.3.1 Navigable Size of Vessels of the Mekong System

The biggest river port in Cambodia is Phnom Penh Port. Located 330 km from the mouth of the Mekong River, Phnom Penh Port is the international port and handles international container transport and oil imports from Ho Chi Minh City, Vietnam. In recent years, the volume of containers handled by the port has shown dramatic growth. The transaction volume has increased by more than ten times from 746 TEU in 2002 to 7,630 TEU in 2003.

The following seven ports, including Phnom Penh Port, are the major river ports in Cambodia.

- 1) Phnom Penh Port
- 2) Kampong Cham Port (on the mainstream of the Mekong River, approximately 100 km upstream from Phnom Penh Port)
- 3) Kratie Port (on the mainstream of the Mekong River, approximately 115 km upstream from Kompong Cham Port)
- 4) Stung Treng Port (on the mainstream of the Mekong River, approximately 150 km upstream from Kratie Port)
- 5) Neak Loeang Port (on the mainstream of the Mekong River, approximately 60 km downstream from Phnom Penh Port)
- 6) Kampong Chunang Port (Tonle Sap River, approximately 90 km upstream from Phnom Penh Port)
- 7) Chong Khneas (Siem Reap) Port (Tonle Sap River, approximately 190 km upstream from Kompong Chunang Port)

Of the river ports mentioned above, container transport is only conducted between Phnom Penh and Kompong Cham. This container transport is exclusively for the transportation of rubber plants, and general cargo is not handled.

In the dry season, vessels are not navigated on the upper section of the Mekong River (upstream from Kampong Cham) or on Tonle Sap River due to the lower water levels. Although it has been said for some time that the inland waterway in Cambodia has a high potential for development, it is observed that development has not proceeded in line with expectations because the difference in water level between the rainy season and dry season is more than 10 m, and accordingly it is difficult to secure appropriate water level and to construct berthing facilities.

The major projects in the MPWT's five-year development plan for the inland waterway transport sector are as follows.

- 1) River bed sounding survey of Suda Canal and the installation of a navigation bouy.
- 2) Survey for dredging of the Mekong River over a 30 km section between Kampong Cham and Kratie.

- 3) Restoration of the river bank damaged by past floods at Koh Brack, Koh Norea and other sites.
- 4) Construction of pontoons at Neak Loeng, Khom Somnar, Kratie and other sites.
- 5) Dredging of the Mekong River over a 194 km section between Phnom Penh and Kratie.
- 6) River investigation of the Mekong, Tonle Sap and Sangker Rivers.
- 7) Construction of workshops.

### 3.3.2 Expected Role of the Inland Waterways

The following two transportation systems are considered for the inland waterways of Cambodia.

- 1) Long-distance inter-regional transportation along rivers

Waterways and railways are superior to road transportation in terms of energy consumption efficiency, and are generally regarded as the most suitable method for long-distance mass transport. Consequently, in relation to freight transport, the inland waterways should normally have an advantage in terms of the 'long-distance inter-regional transportation along rivers'. However, it appears that the river sections where these services can be provided are limited to the lower section of the Mekong River from Kompong Cham as there are many other sections where the water depth required for the navigation of vessels cannot be secured in the dry season. A model by which inland waterway transport is used for regional transportation and the road system for distribution will be applicable where navigation depth can be secured. (Refer to "Pattern 1" on **Figure 3.3.2**)

In terms of passenger transportation, the long-distance inter-regional transportation by inland waterway is limited to tourism services between Phnom Penh and Siem Reap because the share of the long-distance inter-regional transportation will decrease in accordance with the future development of the road network.

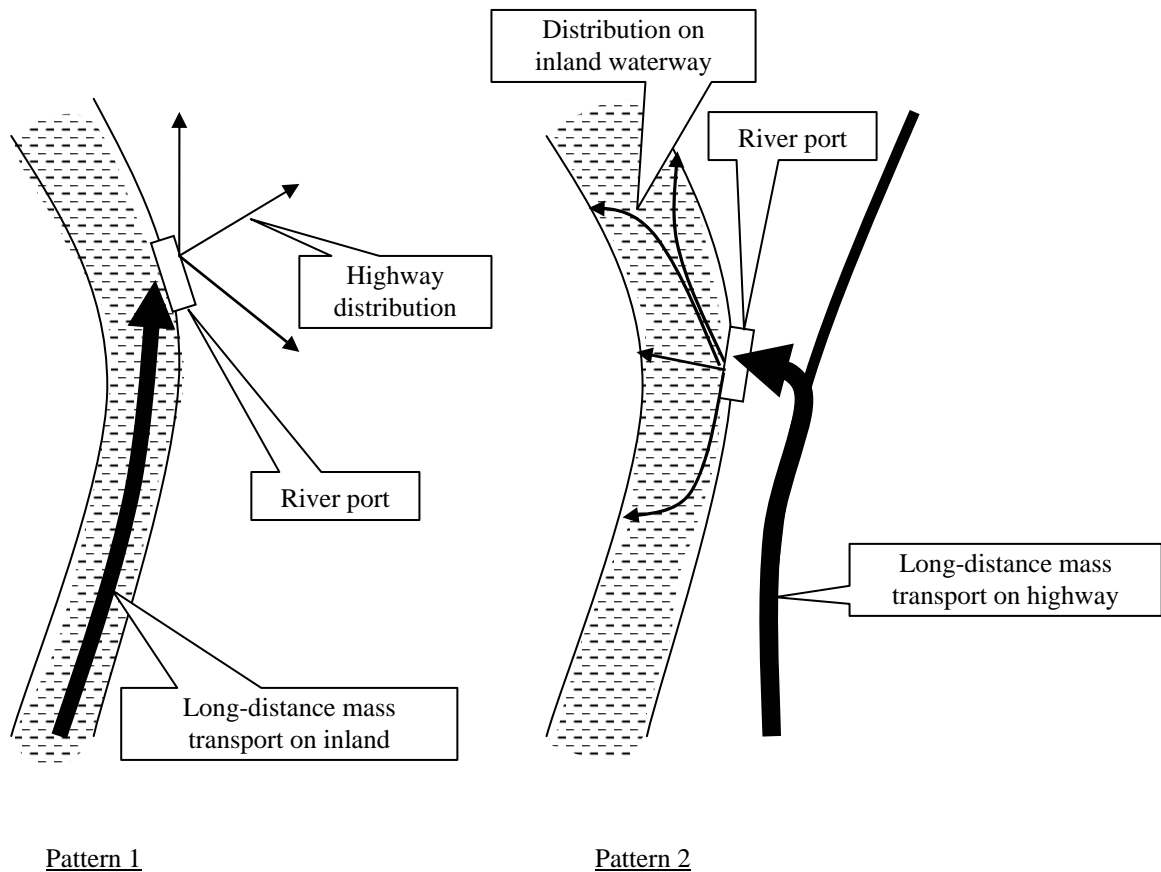
- 2) Short-distance inter-regional transportation across rivers

The roads in Cambodia are severed at various points by the Mekong River and Tonle Sap River. Realistically, it is impossible to construct bridges at various points over the Mekong, Basak and Tonle Sap Rivers, and consequently it is necessary for ferry services to complement the road network for some time.

As a typical example of this situation, the improvement of the transport network in the upper section of the Mekong River, upstream of Kratie, is considered. NR.7 is on the left bank of the Mekong River (on the east side) and is currently under restoration. People on the left bank can directly enjoy the benefits of the restoration work; however, inhabitants on the opposite side of the Mekong River need to use a ferry service to access the opposite bank. To provide this connection, it is necessary to improve ferry services from Stantrein and Kratie (as well as other locations) to the opposite bank and neighboring areas in order to expand the benefits of the

restoration work along NR.7. (Refer to “Pattern B” on **Figure 3.3.2**)

This Study acknowledges the significant role that ferry services play in the regional economy, and examines the linkage of the road improvement projects and ferry services to enhance the effects of regional development.



**Figure 3.3.2** Typical Mixed Transport Pattern by Inland Waterway and Road



## CHAPTER A-4 EXISTING ROAD NETWORK CONDITIONS

### 4.1 Existing Road Network System

The road network development in Cambodia started in the early 1900s with most of the roads, built basically for light vehicles, completed 50-60 years ago. For years, the road network system has contributed greatly to the transport sector in Cambodia and has provided the country's lifeline to the outside world as well as the internal distribution system. However, due to years of destruction, exposure to natural calamities and lack of maintenance, the road network suffered and fell into a serious state of deterioration. The year 2000 flood has brought serious damage to the road network reaching to more than 2,600kms of roads and 3,000m of bridge damaged.

Efforts to rehabilitate and upgrade the road network started in the 1990s with various international donors contributing to the development and by the year 2004, almost 30,258kms of national, provincial and rural roads have been developed. **Figure 4.1.1** shows the present road network in Cambodia.

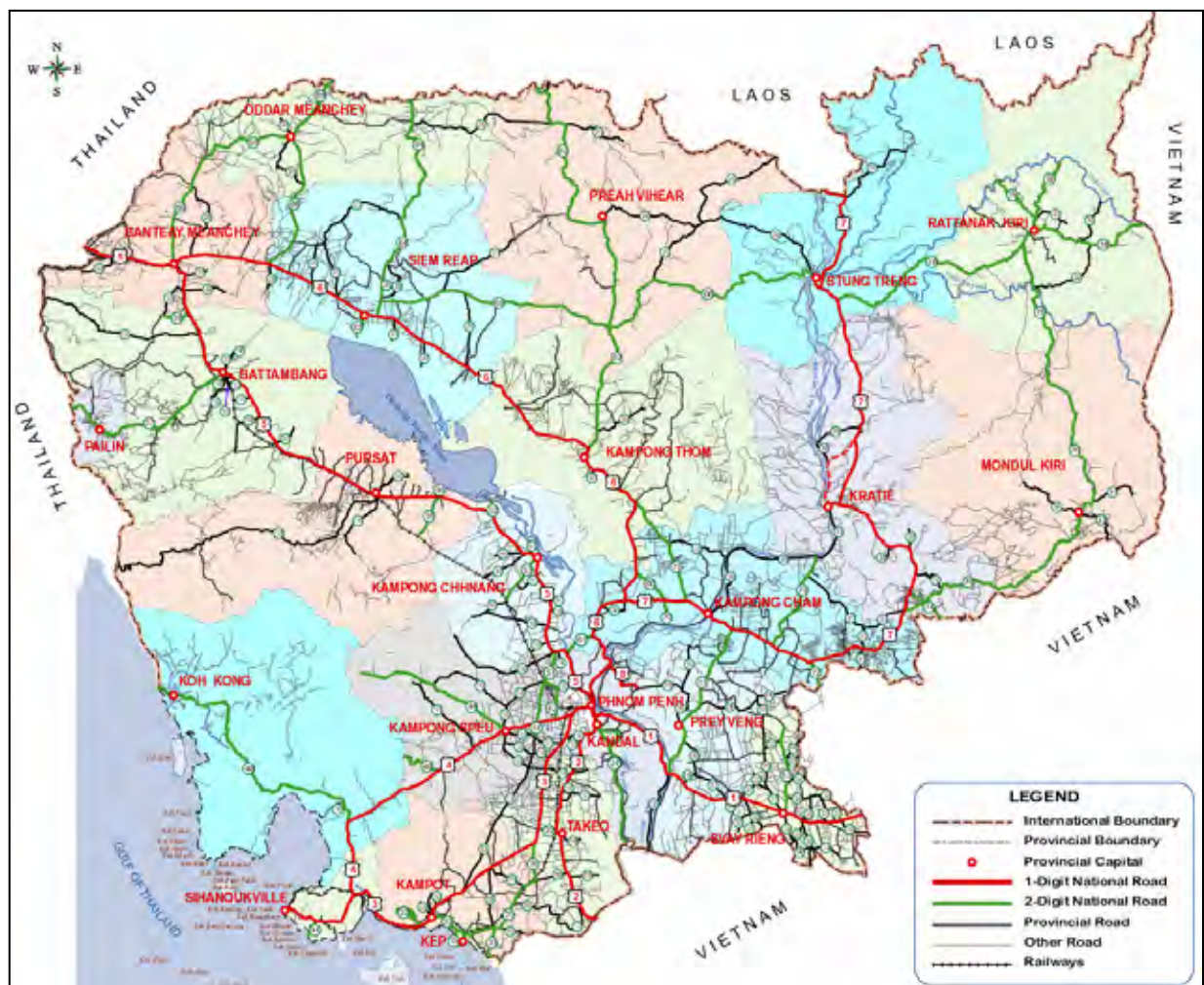


Figure 4.1.1 Existing Road Network in Cambodia

### 4.1.1 Road Networks

The Cambodian Road Network (**Figure 4.1.1**) covers about 30,258 kilometers of paved and unpaved roads, consisting of 4,695 km of national roads (both 1-Digit and 2-Digits), 6,615km of provincial roads and approximately 18,948 km of rural or tertiary roads (**Table 4.1.1 and Figure 4.1.2**).

The primary road network links Phnom Penh to provincial capitals and important centers of population and economic activities. As seen in **Figure 4.1.1**, the basic road network in Cambodia has two principal corridors catering for both domestic and international traffic movements, namely:

- the East-West corridor (NR.1, NR.5, NR.6 & NR.7) traversing Cambodia diagonally in the east-west direction and connecting the countries of Vietnam and Thailand, and
- the North-South corridor (NR.7, NR.3, NR.4 & NR.2) passing in the north-south direction and connecting Laos with the Gulf of Siam and Vietnam.

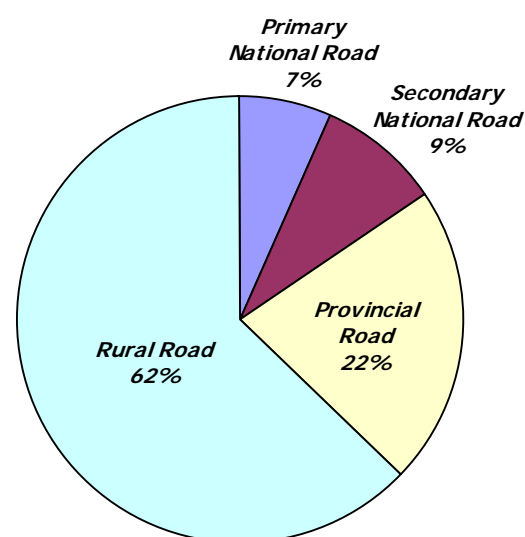
Administration of these roads is basically carried-out by two government agencies in Cambodia, who are responsible for road construction and maintenance:

<i>Ministry</i>	<i>Responsibility</i>
Ministry of Public Works and Transport (MPWT)	<ul style="list-style-type: none"> <li>• National/International Roads</li> <li>• Provincial Roads</li> </ul>
Ministry of Rural Development (MRD)	<ul style="list-style-type: none"> <li>• Rural or Tertiary Roads</li> </ul>

**Table 4.1.1 Road Length by Classification**

Road Classification	Road Length (km)
1-Digit National Road	2,052
2-Digit National Road	2,643
Provincial Road (3 & 4 Digits)	6,615
Rural or Tertiary Road (approximately)	~18,948
<b>Total Length</b>	<b>30,258</b>

\* As of Jan 2006 (National and Provincial Roads based on LRCS Inventory; Rural Road is based on MRD Inventory)



**Figure 4.1.2 Road Network Distribution**

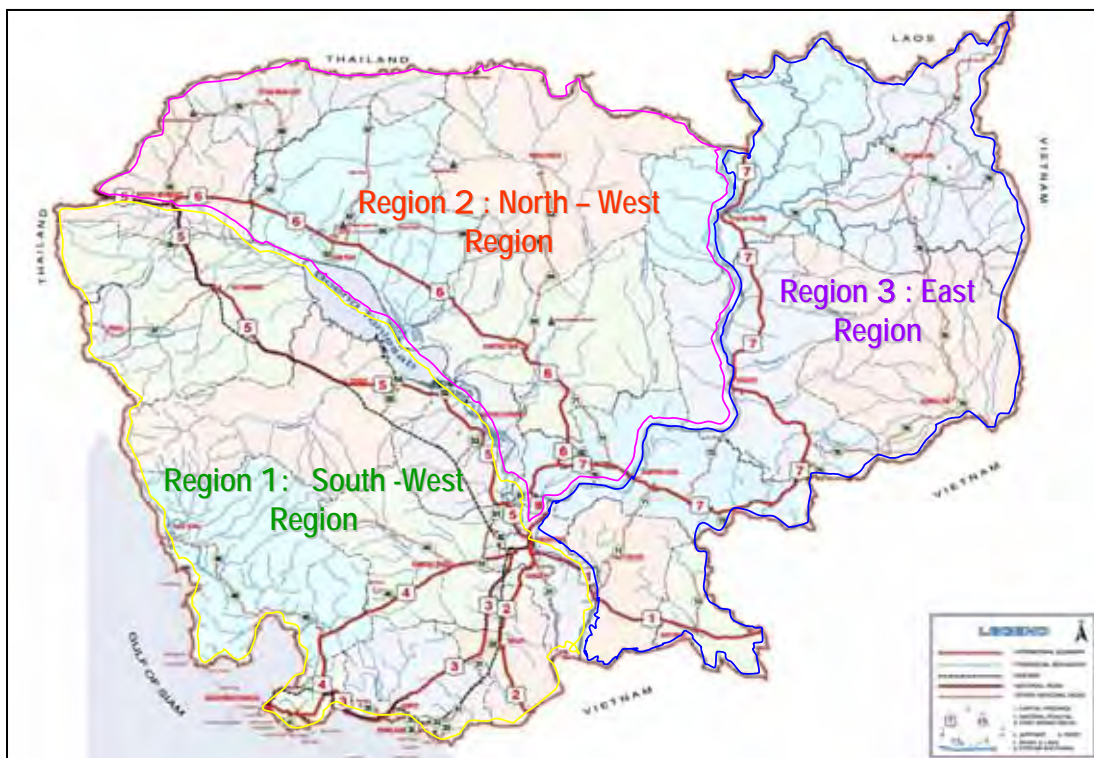
Both these ministries are responsible for the development and implementation of road policies, planning, standards and guidelines for the management and operation of the road network. On the

national road, emergency repairs are being carried-out by the Department of Road Infrastructure (DRI) of MPWT while routine maintenance is the responsibility of the Provincial Department of Public Works and Transport. On the other hand, the road asset management responsibility for rural roads classified as rural or tertiary (road linking district to district) is given to the Provincial Department of Rural Development while sub-tertiary roads will be under the commune or village where the road is located.

### (1) Regional Division of MPWT Roads

The great Mekong river divides Cambodia into eastern and western region while the great Tonle Sap Lake further divides the western part to north and south sections. Due to this geographical division and in an effort to effectively manage the construction and rehabilitation of roads in Cambodia, MPWT divided Cambodia into three regional jurisdiction areas (**Figure 4.1.3**), namely:

- Region 1 – South-West Region (between Mekong downstream and Tonle Sap)
- Region 2 – North Region (between Tonle Sap and Mekong upstream), and
- Region 3 – East Region (between Mekong upstream and downstream)



**Figure 4.1.3 MPWT Regional Distribution of Roads**

The new numbering system considers classifying the provincial roads based on the regional distribution.

## (2) Road Number System for MPWT Roads

The present numbering system for the existing Cambodia Road Network (under MPWT) covers 1-Digit to 3-Digit number roads, as follows:

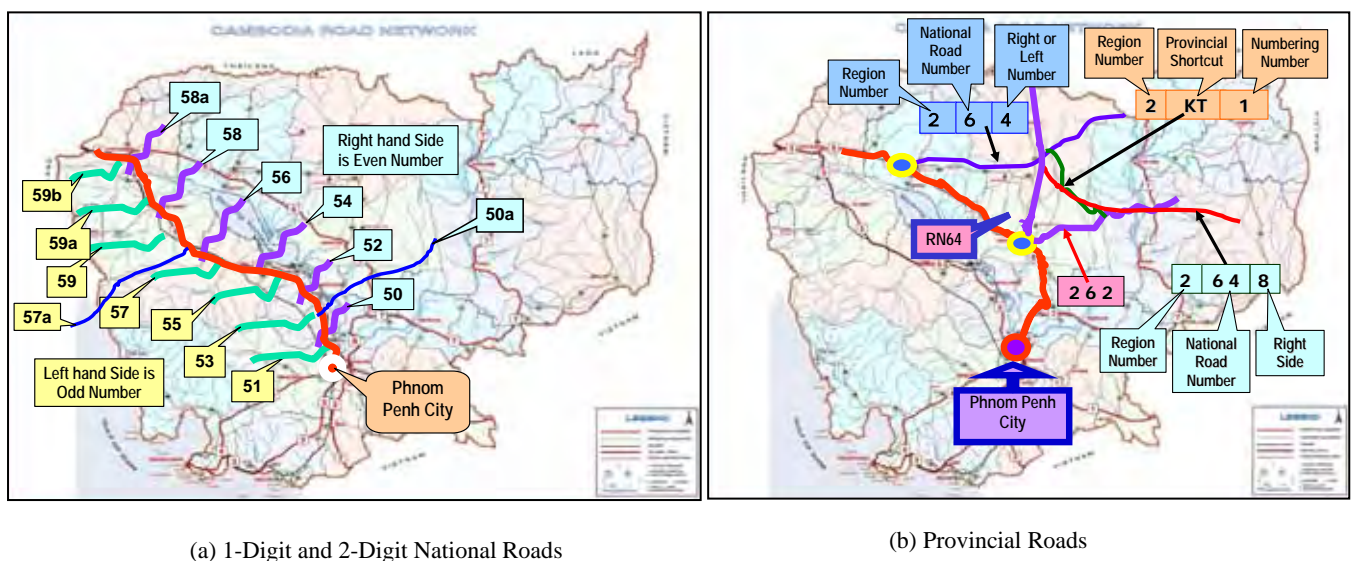
- Primary National Roads – 1-Digit Roads Number (1-9)
- Secondary National Roads – 2-Digit Roads Number (10-99)
- Provincial Roads – 3-Digit Roads Number (100-999)

This number system has been in effect and arbitrarily assigns road numbers to existing and newly constructed road. However, the Department of Road Infrastructure (DRI) recommends a new approach to road numbering to systematically assign road numbers for exiting and new roads. **Table 4.1.2** presents the policy for the new number system.

**Table 4.1.2 New Road Number System**

Road Classification	Description	No. Digits	Policy
1-Digit National Roads	<ul style="list-style-type: none"> <li>• Links Phnom Penh City to Provincial Town</li> </ul>	1-Digit	<ul style="list-style-type: none"> <li>• Road number has been decided from 1 to 8</li> </ul>
2-Digit National Roads	<ul style="list-style-type: none"> <li>• Existing road branches off from 1-Digit National Roads</li> </ul>	2-Digit	<ul style="list-style-type: none"> <li>• Roads starting from right hand side of Primary National Roads are <i>even number</i> - first digit indicates Primary National number; second digit indicates number order (e.g. <u>50</u>, <u>52</u>)</li> <li>• Roads starting from left hand side of Primary National Roads are <i>odd number</i> - first digit indicates Primary National number; second digit indicates number order (e.g. <u>51</u>, <u>53</u>)</li> </ul>
	<ul style="list-style-type: none"> <li>• New road branches off from 1-Digit National Roads</li> </ul>	2-Digit with alphabet	<ul style="list-style-type: none"> <li>• For new roads between two existing roads, an additional alphabet letter shall be added to the previous road number (e.g. <u>57A</u>)</li> </ul>
Provincial Roads	<ul style="list-style-type: none"> <li>• Branches off from 1-Digit National Road</li> </ul>	3-Digit	<ul style="list-style-type: none"> <li>• First digit indicates Region number; second digit indicates Primary National road number; third digit follows right or left number order (e.g. <u>2 6 4</u>)</li> </ul>
	<ul style="list-style-type: none"> <li>• Branches off from 2-Digit National Road</li> </ul>	4-Digit	<ul style="list-style-type: none"> <li>• First digit indicates Region number; second and third digit indicates Secondary National road number; last digit follows right or left number order (e.g. <u>2 64 8</u>)</li> </ul>
	<ul style="list-style-type: none"> <li>• Branches off from Provincial Road</li> </ul>	4 to 5-Digit	<ul style="list-style-type: none"> <li>• First digit indicates Region number; second to fourth digits indicate Provincial shortcut name; last digit is the number order (e.g. <u>2 KT 1</u>)</li> </ul>

The above principle is graphically shown in **Figure 4.1.4**.



**Figure 4.1.4 Sample of New Road Number System**

In this new numbering system, the 1-Digit National Roads keep its original numbers but some of the 2-Digit National Road numbers are changed, depending on its location and orientation. Provincial Roads which originally have 3-Digit numbers will have 3 to 5 alphanumeric designation.

### (3) Design Standard

#### 1) National and Provincial Roads

In 1999, Ministry of Public Works and Transport (MPWT) established the design and construction standards for new roads bridges under its jurisdiction in Cambodia. These design standards aim to (1) maintain a degree of uniformity, particularly across administrative boundaries, (b) enable satisfactory designs to be produced, even where there is not a high degree of expertise, (c) ensure that the road funds were not misspent, through inappropriate designs, or through inadequate provision for future traffic growth or current operations. The construction specification, on the other hand, is intended to be used for the rehabilitation of existing road network, construction of new highways and bridges and maintenance of existing roads and structures.

The following are MPWT's design and construction standards:

- Road Design Standard : (Part 1 – Geometry, Part 2 – Pavement, Part 3 – Drainage)
- Bridge Design Standard : (Base document is Australian Bridge Design Code, 1996)
- Construction Specifications: (For rehabilitation, construction and maintenance)

**Table 4.1.3 Cambodian Road Design Standard and Asian Highway Design Standard**

HIGHWAY / ROAD CLASSIFICATION	CAMBODIA ROAD DESIGN STANDARD											ASIAN HIGHWAY						
	R6	R5	R4	R3	R2	R1	U6	U5	U4	U3	U2	U1	Primary	Class I	Class II	Class III		
Number of Lanes	Depend on Traffic Volume						Depend on Traffic Volume					4 or more	4 or more	2	2			
Design Speed (km/hr)	Flat Terrain (Type I)	120	100	90	70	60	40	100	80	70	60	50	40	100 - 120	80 - 110	80 - 100	60 - 80	
	Rolling Terrain (Type II)	100	80	70	60	50	30	80	60	60	50	40	30	80 - 100	60 - 80	60 - 80	50 - 70	
	Mountainous (Type III)	80	60	60	50	40	20	60	50	50	40	30	20	60 - 80	50 - 70	40 - 60	30 - 60	
Width (m)	Right-of-Way	Rural	Not Specified					Not Specified					50 - 70	50 - 70	40 - 60	30 - 40		
		Urban	Not Specified					Not Specified					40 - 60	40 - 60	30 - 40	30 - 40		
	Lane	Flat/Rolling	3.5	3.5	3.25	3.0	2.75	2.75	3.5	3.5	3.25	3.0	2.75	2.75	3.75	3.50 -	3.50 -	3.00
		Mountainous													3.5-3.75	3.75	3.75	[3.25]
	Shoulder/Sidewalk	Flat/Rolling	3.0	3.0	3.0	2.5	2.0	1.5	3.0	3.0	3.0	2.5	2.0	1.5	1.5 - 3.0	1.5 - 3.0	1.5 - 2.5	1.5 [2]
		Mountainous	2.5	2.5	2.0	2.0	1.5	1.5	2.5	2.5	2.0	1.5	1.5	1.5	2.5	1.5 - 2.5	1.5 - 2.0	1.0-1.5[1.5]
	Min. Median (m)	Flat	6.0	4.0	3.0				4.0	3.0	2.5	2.0						
		Rolling	5.0	3.5	2.5				3.5	2.5	2.0	1.5						
	Mountainous	4.0	3.0	2.0				3.0	2.0	1.5	1.0							
Min. Horizontal Curve Radius (m)	Flat Terrain	420	345		165 [185]	115 [130]	45 [55]	345	210 [255]	165 [185]	115 [130]	75 [90]	45 [55]	390	220	200	110	
	Rolling Terrain	345 [255]	210 [185]	165 [130]	115 [90]	75 [27]	25 [27]	210 [255]	115 [130]	115 [130]	75 [90]	45 [55]	25 [27]	230	120	110	75	
	Mountainous	210 [255]	115 [130]	115 [130]	75 [90]	45 [55]		115 [130]	75 [90]	75 [90]	45 [55]	25 [27]		120	80	50	50	
Max. Superelevation (%)	Rural	10	10	10	10	10	10	10	10	10	10	10	7	8	10	10		
	Urban												6 - 7	6 - 8.7	6	6		
Max. Vertical Grade (%)	Flat Terrain	3-5	3-5			6-8		3-5	4-6		6-8			4	5	6	6	
	Rolling Terrain	4-6	5-7		7-9			5-7	7-9	7-9				5	6	7	7	
	Mountainous	7-9	9-10	9-10				9-10						6	7	8	8	
Minimum Vertical Clearance (m)	Minimum													4.5	4.5	4.5	4.5	
	Desirable													5	5	4.5	4.5	
Design Traffic Volume (ADT <sub>x1,000</sub> )	All	>10	3-10	1-3	0.15-1	<0.15	All	>10	3-10	1-3	0.15-1	<0.15						
Structure Live Loading (Minimum)	T44 / L44 / HLP240						T44 / L44 / HLP241					HS 20-44	HS 20-44	HS 20-44	HS 20-44			
Pavement	Surface Type	Asphalt Concrete / Cement Concrete	Asphalt Concrete / DBST	DBST	DBST	SBST/Lanteite	Lanteite/Gravel	Asphalt Concrete / Cement Concrete	Asphalt Concrete / DBST	DBST	DBST	DBST/Lanteite	Lanteite/Gravel	Asphalt Concrete / Cement Concrete	Asphalt Concrete / Cement Concrete	Asphalt Concrete / Cement Concrete	Double Bituminous Treatment	
	Crossfall (%)	Bituminous - 2.5% - 3%; PCCP - 2%-3%																

NOTES:

1. Min horizontal curve radius for R1-R6 and U1-U6 values are for sealed pavement and "[ ]" values are for unsealed pavement.

2. Classification Definition

2.1 Cambodian Standard

- R6/U6: Highest geometric standard with full access control. Includes rural and international expressways.
- R5/U5: High geometric standard with partial access control. Includes rural highway and arterial.
- R4/U4: Medium geometric standard with partial access control. Includes rural highway, major provincial, minor arterial and major collector.
- R3/U3: Low geometric standard with partial or no access control. Includes minor provincial, and minor collector.
- R2/U2: Lowest geometric standard for local traffic. Includes district roads and local.
- R1/U1: Very low geometric standard for very low traffic where chance of two-way flow is low.

2.2 Asian/ASEAN Highway Standard

- Primary Class: Access controlled motorways
- Class I : 4 or more lanes highway
- Class II : 2 lanes
- Class III : 2 lanes (narrow)

2) Rural Roads

On the other hand, Ministry of Rural Development (MRD), established its standard for rural roads based on MPWT's road standards. The "Work Specifications and Technical Standards for Rural Roads and Bridges (Draft)" was prepared by MRD for implementation of rural roads programs.

3) International Highway Routes

Since part of the Cambodian national road network will become components of the international highway network (Asian/ASEAN/GMS Highway Network), these roads will have to adopt the international design standard applied for these highway routes. The following standards constitute the international design standard applicable to Cambodia:

- Asian Highway Design Standards, UNESCAP 1995
- ASEAN Highway Design Standard
- Annex 11: Road and Bridge Design and Construction Standards and Specifications, "The Agreement Between and Among the Governments of the Kingdom of Cambodia, the Peoples Republic of China, the Lao People's Democratic Republic, the Union of Myanmar,

the Kingdom of Thailand, and the Socialist Republic of Vietnam for the Facilitation of Cross-Boarder Transport of Goods and People” , April 30, 2004.

#### 4) Applicability of Design Standards

It is observed that in most foreign-assisted projects in Cambodia (covering 1-Digit and 2-Digit national roads), various donor countries and institutions still adopt different design standards in different road sections. For instance, the 1-Digit national road is a showcase of different road standards including Cambodian Standard, American Association of State Highways and Transportation Officials (AASHTO), Japan Road Association (JRA), Korean Standard and Chinese Standard.

However, this study will conform, as much as possible, to the Cambodian Road Design Standards and the Asian Highway Design Standard. **Table 4.1.3** summarizes the typical requirements of both standards.

#### **4.1.2 Administrative Classification**

Although various classification schemes exist for highway systems, there are two most widely used road classification for transportation planning – the administrative classification and the functional classification.

The administrative classification categorizes the roads according to the government agency responsible for the construction and maintenance of the road. Typical classification in Cambodia categorizes roads into National Roads, Provincial Roads and Rural/Tertiary (District, Commune or Village) Roads. Under such hierarchy of administrative classification, arterial roads which cater for nation-wide traffic are classified as national roads while the roads which serve to regional and local traffic are classified as provincial and tertiary/rural roads, respectively in accordance with the characteristics of the traffic on the road.

On the other hand, the functional classification refers to road classification according to the character of service the road provides and the role it plays in the road network. Typical functional classification categorizes roads into major (or principal) arterial, minor arterial, collector/distributor and local roads. This concept is used in the Cambodian Road Standard which classifies rural roads into International Expressway, Highway, Provincial Roads and District while the urban roads are classified as Urban Expressway, Arterial, Collector Roads and Local roads.

The definition of road function according to administrative classification is presented in **Table 4.1.4**.

**Table 4.1.4 Road Classification by Administration**

Road Classification	Road Section	Jurisdiction	Definition/Function	Roadside Clearance from Road Centerline (m)	Description
National/ International Road	<ul style="list-style-type: none"> <li>Primary National Road: Single-Digit Number (e.g. NR1 – NR7)</li> <li>Secondary National Road: Two-Digit Number (e.g. NR11, NR51, etc.)</li> <li>Asian/ASEAN Highway and Regional Highway (e.g. AH1, AH11, R9, R10)</li> </ul>	Ministry of Public Works and Transport (MPWT)	<ul style="list-style-type: none"> <li>Connects Cities to Provincial Town</li> <li>Connects Provincial Town to Provincial Town</li> <li>From National Road Junction to Provincial Town</li> <li>From National Road Junction to National Road</li> <li>Provides regional and cross-border access and connection</li> <li>As Specified by MPWT</li> </ul>	30 (NR1, NR4, NR5) 25 (NR2, NR3, NR6, NR7) 25 (NR11, NR22, NR64, NR78) 25-35 (Asian/Regional Highway)	Constitutes the backbone of inter-provincial national network and links up directly or indirectly the provincial capitals and major points of entry/exit to the country.  Forms part of the regional highway system including Asian Highway Network and connects Cambodia with the neighboring countries. NR1 & NR5 becomes part of Asian Highway AH1 while NR7 & NR4 becomes part of AH11.
Provincial Road	<ul style="list-style-type: none"> <li>Three-Digit Number (e.g. 101, 201, 301, etc.)</li> <li>Four-Digit Number (e.g. 1311, 2710, 3710, etc.)</li> </ul>	Ministry of Public Works and Transport (MPWT)	<ul style="list-style-type: none"> <li>Connects Provincial Town to District Center</li> <li>From National Road Junction to District</li> <li>From Provincial Road Junction to District Center with ADT &gt; 50 (ADT : Average Daily Traffic)</li> <li>From Provincial Road Junction to Provincial Road</li> <li>Tertiary Road with ADT &gt; 50</li> <li>As Specified by MPWT</li> </ul>	20	Constitutes major roads forming the basic network of the road transportation system within the province and links up provincial capitals and major district centers.
Tertiary/Rural Road	<ul style="list-style-type: none"> <li>Tertiary : District to District</li> <li>Sub-Tertiary 1 : District to Commune</li> <li>Sub-Tertiary 2 : Commune to Commune</li> <li>Sub-Tertiary 3 : Commune to Village and Village to Village</li> </ul>	Ministry of Rural Development (MRD)	<ul style="list-style-type: none"> <li>From National Road Junction to Commune, Village</li> <li>From Provincial Road Junction to Commune, Village</li> <li>Connects District Center to District Center</li> <li>Connects District Center to Commune Center</li> <li>Connects Commune Center to Commune Center</li> <li>Connects Commune Center to Village</li> <li>Connects Village to Village</li> <li>From Tertiary Road Junction to Tertiary Road</li> </ul>	15	Forms the basic network within a rural area and serve mainly local traffic with short trips.

The functional classification of roads and highways is intended to handle the stages of traffic travel movements which include main movement, transition, distribution, collection, access and termination. Each travel movement stage is handled specifically by a separate facility intended to serve its function.

The Cambodian Road Design Standard (MPWT, 2003) functional classification of roads and highways separates rural road classification from urban road classification. Each road category has four highway systems as follows:

- Rural Roads – International Expressway, Highway, Provincial Roads and District Roads
- Urban Roads – Urban Expressway, Arterial, Collector Roads and Local Roads

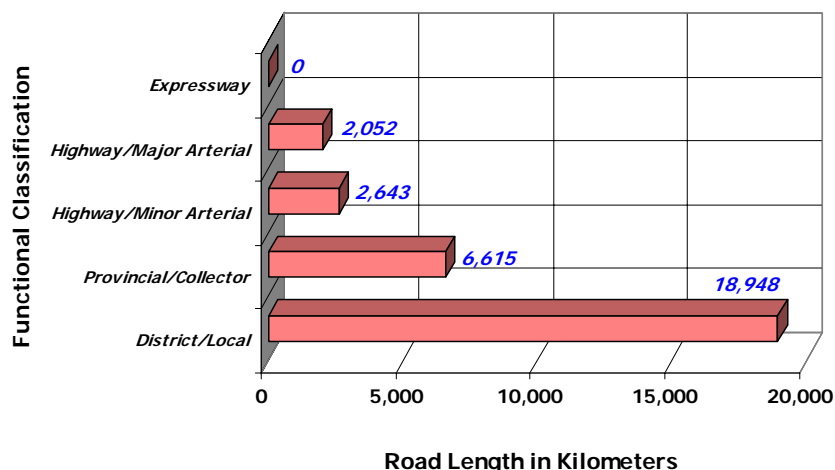
**Table 4.1.5** presents the general characteristics of the road categories and functional classification system in Cambodia.



**Table 4.1.5 Functional Characteristics by Road Category**

Class Level	Rural Roads	Design Speed (km/hr)	Urban Roads	Design Speed (km/hr)
I	<b>International Expressway</b> An International Expressway is a divided highway for through traffic with, full control of access and always with grades separations at all intersections. They apply to the inter-provincial highways and make the basic framework of national road transportation for high speed traveling. They serve long trips and provide the highest speed of traveling and comfort. To maintain this, they are fully access-controlled and are designed to the highest standards.	80 - 120	<b>Urban Expressway</b> An Urban/International Expressway is a divided highway for through traffic with, full control of access and always with grades separations at all intersections. They form the basic framework of road transportation system in urbanized area for through traffic. They also serve relatively long trips and smooth traffic flow and with full access control and complement the Rural Expressway system	60 - 100
II	<b>Highway</b> They constitute the backbone of the inter-provincial national network and complement the expressway network. They usually link up directly or indirectly the Provincial Capitals and major points of entry/exit to the country. They serve long to intermediate trip lengths. Speed service is not so important as in an Expressway but relatively high to medium speed is necessary. Smooth traffic is provided with partial access control.	60 - 100	<b>Arterial</b> An arterial is a continuous road with partial access control for through traffic within urban areas. Basically it conveys traffic from residential areas to the vicinity of the central business district or from one part of a city to another which does not intend to penetrate the city centre. Arterial roads do not penetrate identifiable neighborhoods. Smooth traffic flow is essential since it carries large traffic volume.	50 - 80
III	<b>Provincial Roads</b> They constitute the major roads forming the basic network of the road transportation system within a province. They serve intermediate trip lengths and medium traveling speeds. Smooth traffic is provided with partial access control. They usually link up the Provincial Capitals and major district centers.	50 - 90	<b>Collector Roads</b> A collector road is a road with partial access control designed to serve on a collector or distributor of traffic between the arterial and the local road systems. Collectors are the major roads that penetrate and serve identifiable neighborhoods, commercial areas and industrial areas.	40 - 70
IV	<b>District</b> They apply to all roads other than those described above in the rural areas. They form the basic road network within a Land Scheme or other inhabited areas in a rural area. They also include roads with special functions such as holiday resort roads, security roads or access roads to government institutions. They serve mainly local traffic with short trip lengths and are usually with partial or no access control.	20 - 60	<b>Local</b> The local street system is the basic road network within a neighborhood and provides direct access to abutting land. They are links to the collector road and thus serve short trip lengths. Through traffic should be discouraged.	20 - 50

Although the road categories and functional classification is clearly stated in the Cambodian Road Design Standard, the present road classification still relies on the administrative jurisdiction classification putting emphasis on the roles and importance of 1-Digit and 2-Digit national roads. Expressway (International or Urban class) is still non-existent in Cambodia. However, the backbone of the national road network system relies heavily on 1 and 2-Digit highways which can be considered as major and minor rural arterials, respectively.



**Figure 4.1.5 Functional Classification of Roads**

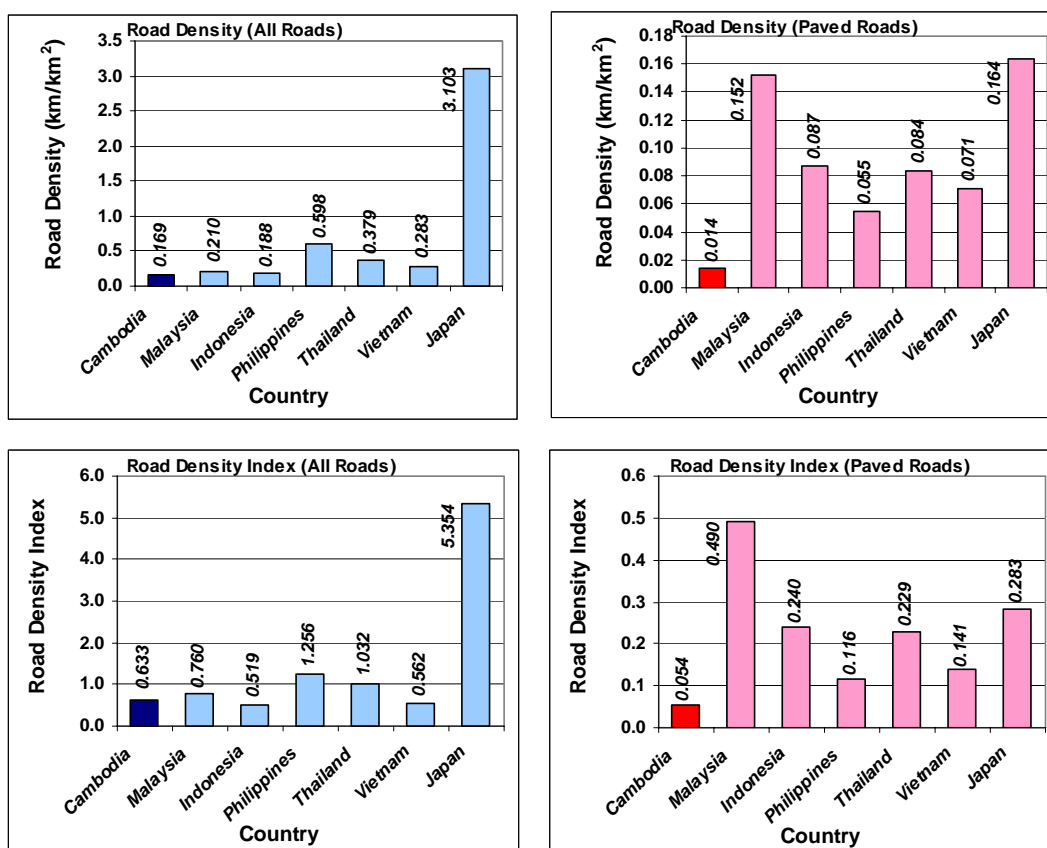
### 4.1.3 Road Density and Road Density Index

The Road Density (RD) is taken as a measure of the degree of road infrastructure development in an area or a country. This is used to confirm the necessity of road development in Cambodia comparing the level with other developing countries.

On the other hand, when population is taken into consideration, the Road Density Index (RDI) can be used to compare the denseness of the road network. This index is used in consideration that densely populated areas needs more road than sparsely populated areas.

**Table 4.1.6 Road Density and Road Density Index in Cambodia**

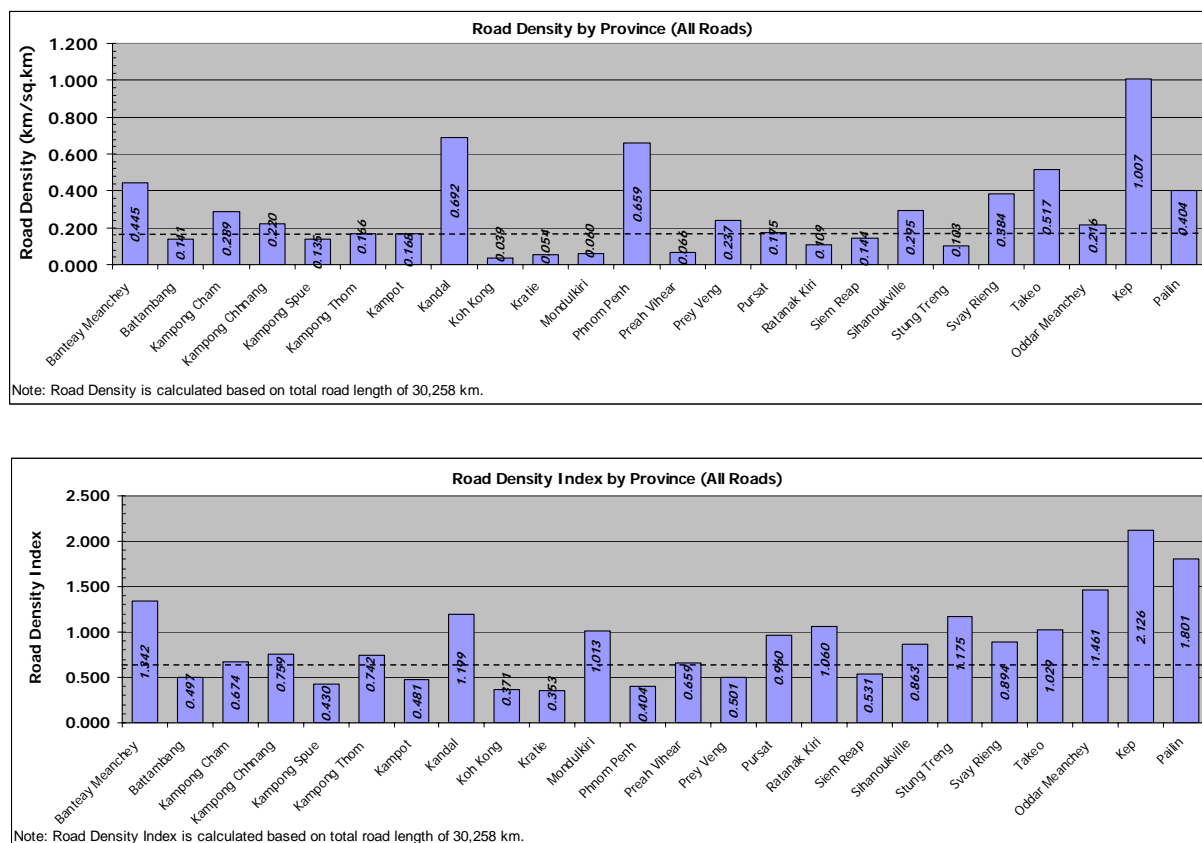
Road Length, L (km)	All Roads	30,258
	National and Provincial Roads	11,310
Total Land Area, A (km <sup>2</sup> )		181,035
Population, P (x1,000)		12,762
Road Density, RD (km/km <sup>2</sup> ) RD = L / A	All Roads	0.169
	National and Provincial Roads	0.063
Road Density Index, RDI RDI = L / √ PxA	All Roads	0.633
	National and Provincial Roads	0.237



**Figure 4.1.6 Road Density and Road Density Index of Selected Countries**

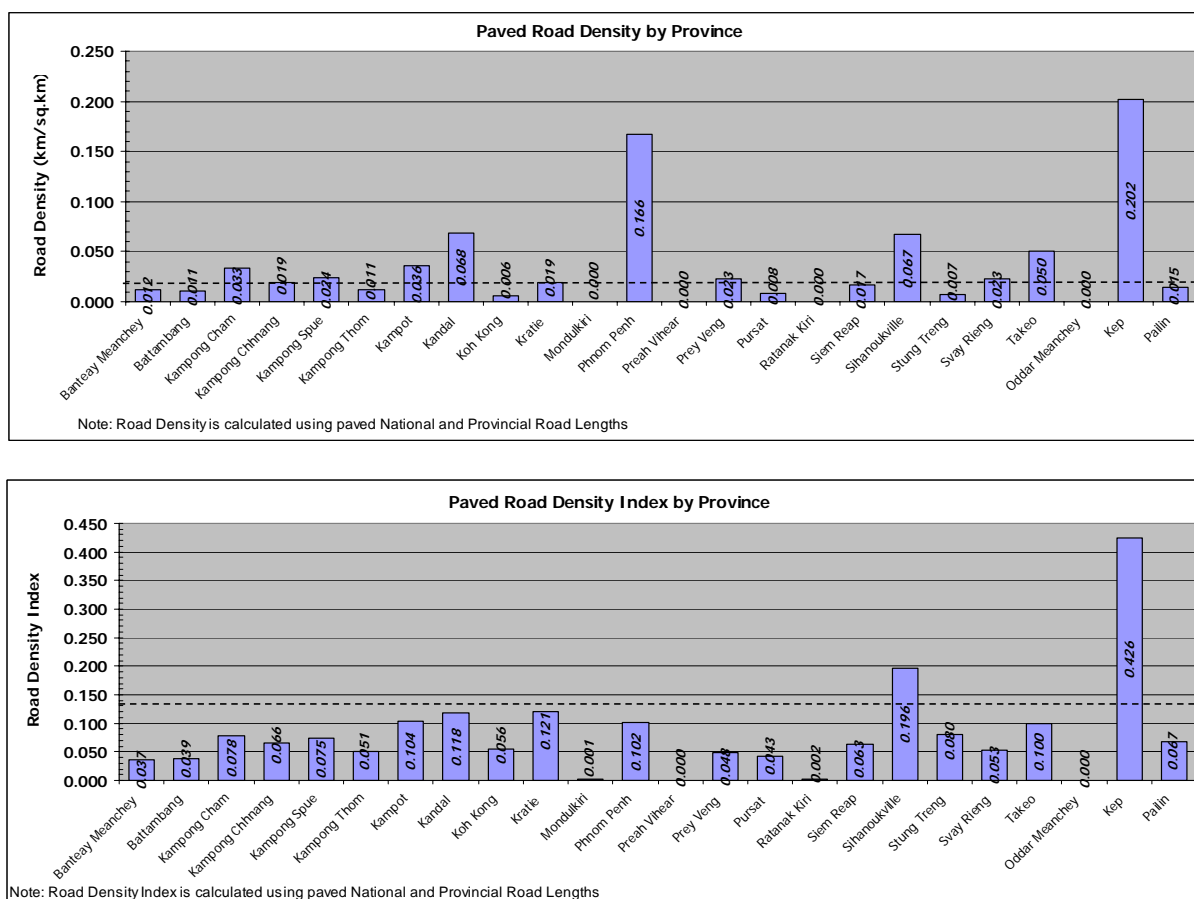
In **Table 4.1.6**, the road density and the road density index of the existing road network is calculated to be  $RD = 0.169$  and  $RDI = 0.633$  respectively. In **Figure 4.1.6**, the road density in Cambodia (considering the overall road network) is comparable to that of other Asian countries, except Japan and Philippines with  $RD$  of 3.103 and 0.598. Similarly, the road density index for the entire road network in Cambodia is comparable to other Asian countries except Japan which has an  $RDI$  of 5.354. However, if paved national road is considered, Cambodia has the lowest road density and road density index among these countries.

The road density and road density index are calculated at the provincial level in Cambodia to determine the degree of road development and compare the denseness of the road network considering the population in each province. A comparison of the road density and road density index (considering all national, provincial and rural roads, except city roads) for the different provinces are presented in **Figure 4.1.7** below. As seen in the figures, although some of the provincial road density falls below the national average, the road density indices are higher than the national average. This can be one of the indicators that can be used to prioritize which areas to develop the road network due to the needs of the population.



**Figure 4.1.7 Road Density and Road Density Index Per Province in Cambodia (National, Provincial and Rural Roads)**

As mentioned earlier, the road density and road density index of paved road in Cambodia is among the lowest in the region. However, if we consider the degree of paved road development at the provincial level, it is seen that some provinces have very low paved road with Preah Vihear, Oddar Meanchey, Rattanak Kiri and Mondulkiiri practically having no paved road, as seen in **Figure 4.1.8**. This has made travel in such areas very difficult especially during rainy season. Moreover, it is observed that provinces with very low paved road ratio are economically less developed.



**Figure 4.1.8 Road Density and Road Density Index of Paved Road by Province in Cambodia**

#### 4.1.4 Regional Highway, Asian Highway and ASEAN Highway Network

The *Asian Highway Network* was conceptualized in 1992 to promote and develop international road transport, strengthen relations and promote international trade and tourism in Asia and the neighboring regions. It consists of highway routes of international importance within Asia, including highway routes substantially crossing more than one sub-region, highway routes within sub-regions, and highway routes within member countries. The road network covers 55 routes in 32 Asian countries and spanning 141,000kms.

The *ASEAN Highway Network* first emerged in the late 1980s to establish and develop an

integrated and harmonized Trans-ASEAN transportation network as the trunk line or main corridor for movement of goods and people in ASEAN member countries. This network covers 27 routes in 12 member countries and spans 37,070kms. In some countries like Cambodia, the ASEAN Highway route overlaps with the Asian Highways and takes the same route number as the Asian Highway.

In 1999, the ASEAN Transport Ministers endorsed the development of the ASEAN Highway Network Project with the following development strategy and implementation (**Table 4.1.7**):

**Table 4.1.7 Implementation Plan for the ASEAN Highway**

Phase	Tentative Completion Year	Technical Requirement
Stage 1	2000	Network configuration and designation of national routes to be completed
Stage 2	2004	<ul style="list-style-type: none"> <li>• Road signs for all designated national routes to be installed.</li> <li>• All designated national routes upgraded to at least Class III standards.</li> <li>• All missing links to be constructed.</li> <li>• All designated cross-border points to be operational.</li> </ul>
Stage 3	2020	<ul style="list-style-type: none"> <li>• All designated national routes upgraded to at least Class I or Primary Road standards.</li> <li>• For low traffic volume, non-arterial routes, Class II standards are acceptable.</li> </ul>

However, Stage 2 technical requirements are still far from completion in some member countries including Cambodia. For instance, standard road signs will still have to be in place and completed, missing links will still have to be constructed and roads below Class III standard will have to be upgraded.

The ASEAN Highways are classified into four types with road classification standards based on the number of lanes and pavement types as presented in **Table 4.1.8**.

**Table 4.1.8 ASEAN Highway Road Classification**

Classification	Description	Pavement Type
Primary	Access controlled motorway	Asphalt or Cement Concrete
Class I	4 or more lanes highway	Asphalt or Cement Concrete
Class II	2 lanes	Asphalt or Cement Concrete
Class III	2 lanes (narrow)	Double Bituminous Treatment

**Figure 4.1.9**, illustrates three ASEAN Highway route (two of which overlaps with the Asian Highway route) in Cambodia with a total length of 1,490.7kms. The longest route is AH11, which starts from Sihanoukville (Gulf of Thailand) through Phnom Penh and Stung Treng to

Trapeangkreal (Lao PDR border), covering a total length of 755kms. This is the major route corridor connecting southwest and northeast area in Cambodia.

Another major arterial is the 572.4km AH1 that connects Poi Pet (Thailand border), Sisophon, Phnom Penh and Bavet (Vietnam border). The last ASEAN Highway route is the 163.3km AH123 route linked to AH11 which overlaps with the coastal subcorridor of the Greater Mekong Subregion road network corridor.

In order to provide a basic framework for facilitating cross-border movement of goods and people, the six countries in the Greater Mekong Subregion (GMS) signed the *Agreement to Facilitate the Cross-Border Transport of Goods and People in the Greater Mekong Subregion (CBTA)* which entered into force on December 31, 2003. Under this framework, four transport corridors spanning 1,955.6km of road were formed within Cambodia as shown in **Figure 4.1.9**. Three of these corridors, however, overlap with the Asian and ASEAN Highway road network as presented in **Table 4.1.9**.

**Table 4.1.9 International Highway Routes in Cambodia**

Route	GMS Road Designation	Asian Highway Designation	ASEAN Highway Designation	Cambodian National Road Designation	Total Length (km)
Poipet – Sisophon – Phnom Penh – Bavet	Central Subcorridor	AH1	AH1	NR.1, NR.5	572.4
Sihanoukville – Phnom Penh – Kampong Cham – Stung Treng – Trapengkreal	Inter-Corridor Link	AH11	AH11	NR.4, NR.6, NR.7	755.0
Cham Yeam – Koh Kong – Phum Daung Bridge – Sre Ambel – Chamkar Luong	Southern Coastal Subcorridor	-	AH123	NR.48, NR.3, NR.33	163.3
Siem Reap – Preah Vihear – Stung Treng – Rattanak Kiri – O Yadav Border	Northern Subcorridor	-	-	NR.66, NR.78	464.9
<b>Total Length (km)</b>					<b>1,955.6</b>

**Table 4.1.10** presents the status of the International Highway routes in Cambodia. About 377.6kms of the route has been improved to Class II condition with plans to upgrade another 103kms by 2009 under ADB and Japan Grant. However, about 960.9kms of road route belong to Class III standard while another 617.1kms of road are still below Class III standard.

103kms of NR.7 with 1,050m bridge is presently undergoing rehabilitation under China fund for Class III standard.

Route NR.48 and NR.78 (partial) will be improved to Class III standard by Thailand and Vietnam

funds, respectively.

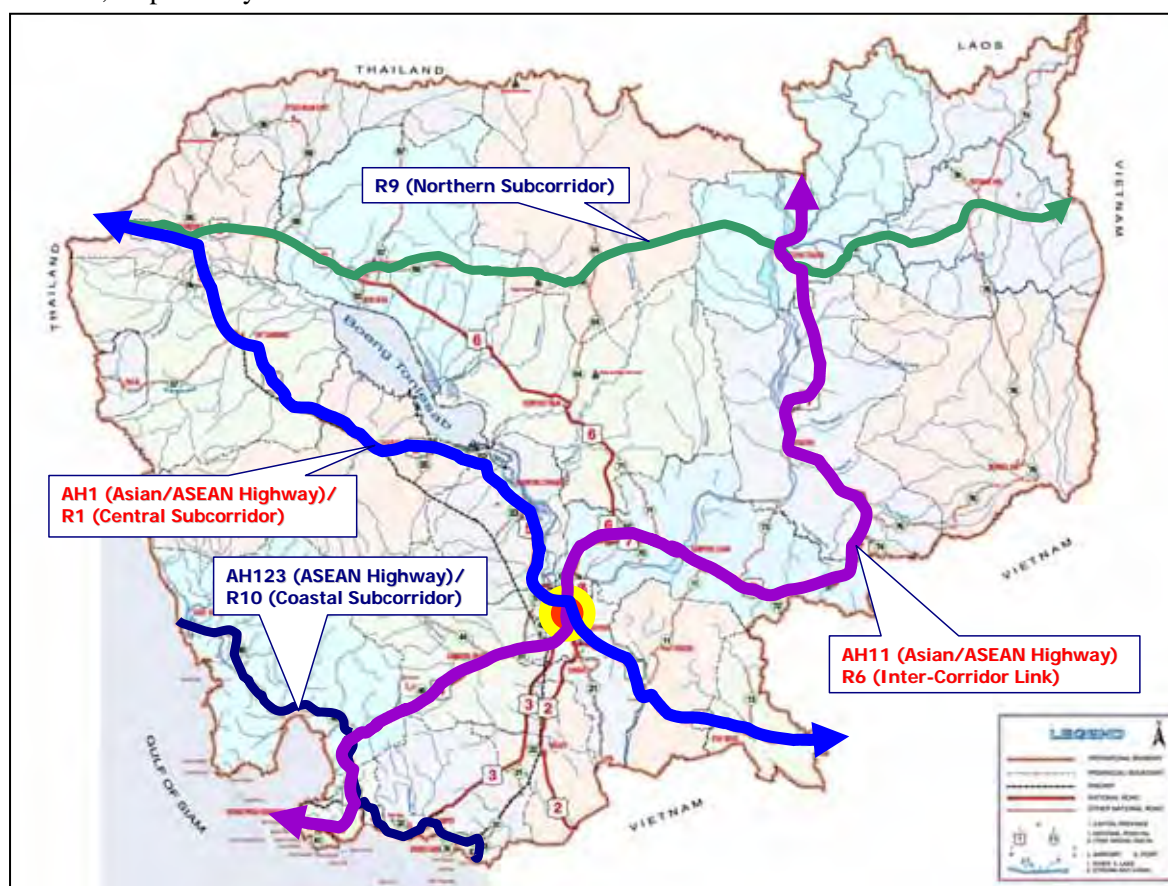


Figure 4.1.9 International Highway Routes in Cambodia

Table 4.1.10 Status of International Highway Routes in Cambodia

July 2005

Route No.	Route Description	Length (km)	Primary	Class I	Class II	Class III	Below Class III	Missing Links
AH 1	Poipet – Sisophon – Phnom Penh – Bavet (NR1, NR5)	572.4	-	-	11.2	561.2*	-	-
AH 11	Sihanoukville – Phnom Penh – Kampong Cham – Stung Treng – Trapengkreal (NR4, NR6, NR7)	755.0	-	-	364.0	391.0**	-	-
AH 123	Cham Yeam – Koh Kong – Phum Daung Bridge – Sre Ambel – Chamkar Luong (NR48, NR3, NR33)	163.3	-	-	2.4	8.7	152.2	-
Northern Subcorridor	Siem Reap – Preah Vihear – Stung Treng – Rattanak Kiri – O Yadav Border (NR66, NR78)	464.9	-	-	-	-	464.9	-
<b>Total Length (km)</b>		<b>1,955.6</b>	-	-	<b>377.6</b>	<b>960.9</b>	<b>617.1</b>	-

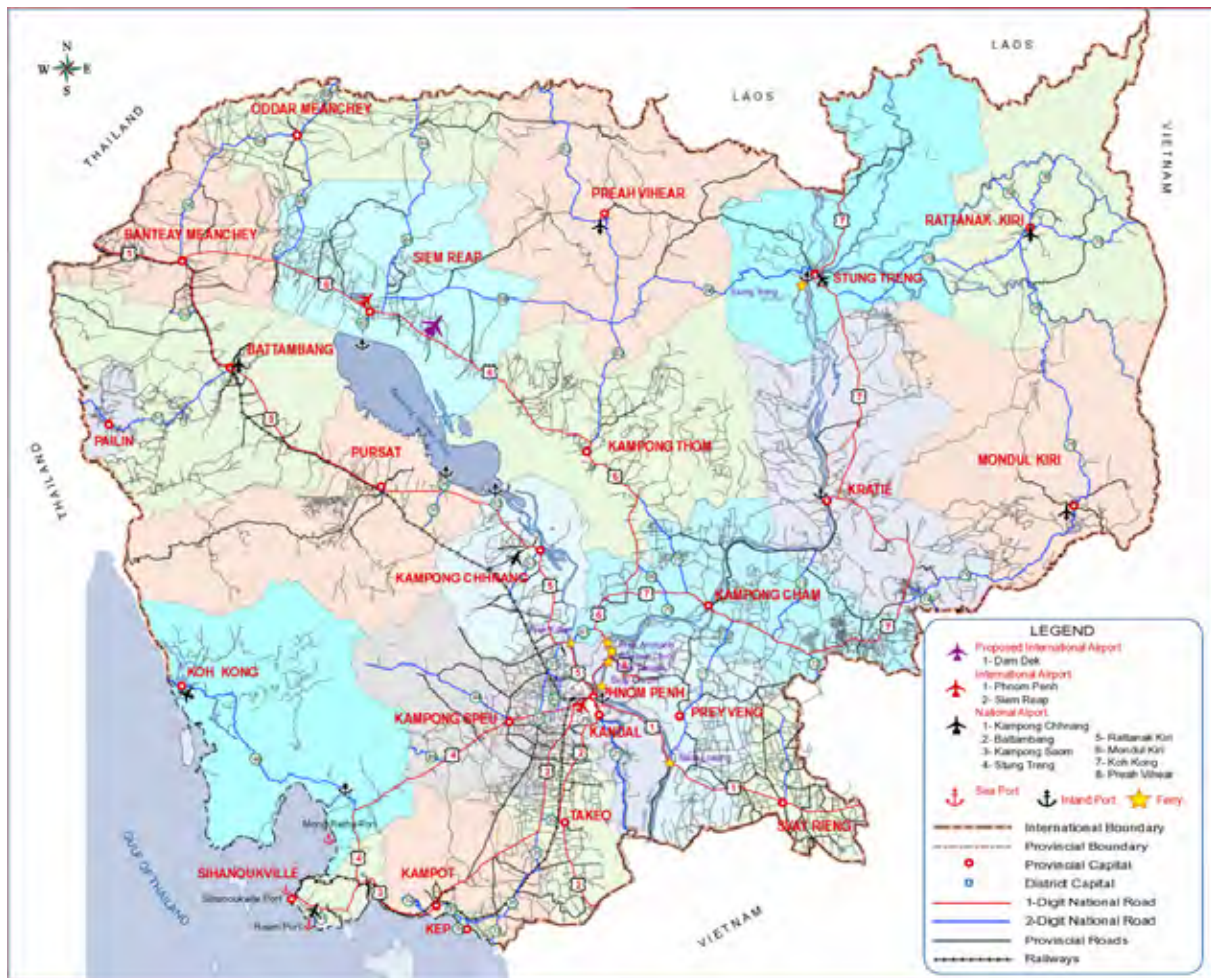
\*103km will be upgraded to Class II (Japan – 56km and ADB – 47km)

\*\*Includes 193km on-going Road Rehabilitation of NR.7

(China fund) \*\*\*NR.48 (AH123) will be funded by Thailand \*\*\*\*NR.78 will be partly funded by Vietnam

#### 4.1.5 Road Network Coverage

The road coverage in the Kingdom of Cambodia is shown in **Figure 4.1.10**. As can be seen in the figure, the road network consisting of national, provincial and rural roads provides access to major areas and important points.



**Figure 4.1.10 Road Network Coverage in Cambodia**

##### (1) Access to Provincial Centers

At present, the Kingdom of Cambodia is divided into 24 provinces, 185 districts, 1,621 communes and 13,703 villages. Accesses to these areas are provided by the national, provincial and rural road networks. However, 1-Digit (primary) national road (highest class in Cambodia) links Phnom Penh directly to only 16 Provincial Centers (see **Figure 4.1.10**) with the 8 remaining provinces connected by 2-Digit (secondary) national roads branching off from the 1-Digit national roads. It should be noted that the present conditions of the 1-Digit roads varies from fair to good which is expected to be all paved (except NR.8) once road improvement projects are completed. On the other hand, the present condition of the 2-Digit national roads varies from fair to very poor. Connection to such



provincial centers should be given priority.

## **(2) Access to District Centers**

Road accesses to district centers are provided by provincial roads which covers 22% of the total road network in Cambodia. However, 98.4% of the provincial roads have either laterite or earth pavement types whose conditions vary from fair to very poor. Improvement of these roads and increasing its paved road density will have to be addressed in the master plan.

## **(3) Access to Commune and Villages**

The rural roads under MRD provide access to commune and villages in the rural areas of Cambodia. Although rural roads constitute about 62% of the total road network in Cambodia with a density of about 0.11km/km<sup>2</sup>, majority of these roads are in poor condition and not passable during rainy season. Improving the road condition and capacity will be the focus of rural road development.

## **(4) Connection to Airports, Sea Ports and Inland Ports**

There are basically two international airports in Cambodia (Phnom Penh and Siem Reap) with one being new international airport being proposed east of Siem Reap (see **Figure 4.1.10**). Connections to these two international airports are basically provided by 1-Digit roads. On the other hand, there are eight (8) national airports with access provided by 2-Digit roads.

There are three seaports along the Gulf of Thailand in Cambodia – the Sihanoukville Port, Ream Port and Mong Rethy Port. Road network connections to these sea ports are provided by national and provincial roads. Moreover, inland ports on major rivers are connected to the road network by 1-Digit and 2-Digit national roads. Conditions of these roads leading to airports, sea ports and inland ports should be improved and maintained.

## **(5) Bridge Crossings and Ferry Services on Major Rivers**

At present, there are only three bridges crossing major rivers (Mekong River, Tonle Sap River and Bassac River) in Cambodia. In the absence of bridge crossings and to complement the road network, at least seven ferry services are in operation along Mekong and Tonle Sap rivers which transport passengers, cargos and vehicles from one bank to the other bank of the river. Although this system is cheaper than bridge investment costs, it would be better to build additional bridges in the long term to provide safer, faster and more reliable transportation means.

## **4.2 Current Road Rehabilitation/Maintenance Studies and Projects By Bilateral and Multilateral Donors**

Road Investments in the national roads in Cambodia from mid-1990s to present amounts to more than \$700 million with more than 2,200kms of road completed or undergoing construction (see **Figure 4.2.1** and **Table 4.2.1**). Such road improvement is basically focused on 1-Digit national

roads (75%) with important 2-Digit national roads (25%) included in the program.

**Table 4.2.1 Major Road Improvement/Rehabilitation Projects**

Project Name	Year		Length (km)	Cost (US\$ Mil)	Project Type		Status	Note
	Start	End			Fund	Donor		
Asian Highway Improvement (NR-1:Neak Loeung - VN Border)	1999	2005	105.0	51.0	Loan	ADB	Completed	PK62-PK167.5
Improvement of NR-1 (Phnom Penh - Neak Loeung Section)	2005	2010	56.0	45.0	Grant	Japan	Under Tendering	Monivong Bridge - Neak Loung
Construction of Neak Loeung Bridge on NR-1	2008	2010		120.0	Grant	Japan	Under F/S	
Primary Road Restoration Project (ADB 1697)	2000	2004	407.0	88.2	Loan	ADB	Completed	NR-5 (Phnom Penh ~ Sisopong) NR-6 (PK167-PK237) NR-7 (NR-11 ~ Kracheh)
Emergency Flood Rehabilitation Project (ADB-1824)	2001	2004	368.0	41.0	Loan	ADB	Completed	NR-1 (PK24-PK60) NR-2 (PK 11 - PK 78) NR-5 (PK 91 - PK172 and PK304 - PK359) NR-6 (PK 76 - PK166) NR-11 (PK61-PK151) NR-21 (PK 15 - PK 45) NR-71 (PK 0.0 - PK33.6)
Cambodia Road Rehabilitation Project	2001	2005	93.9	45.6	Loan	WB	Completed	NR-3 Sihanouk Ville NR-6 Siem Reap
Flood Emergency Rehabilitation Project	2002	2004	113.0	12.2	Loan	WB	Completed	NR-31 (PK0-PK55) NR-33 (PK0- PK42) NR-61 (PK0-PK16)
NR-78 Improvement (Ban Lung - VN Bolder)	2005	2007	70.0	28.0	Grant and Loan	Vietnam	Expected to start 2005	
Rehabilitation of NR-2 (Takeo - VN Border)	2003	2005	51.6	12.0	Grant	Japan Non-Project Found	On-going	PK74-PK125.6
NR-3 Kampot - Trapang Ropaou Road Rehabilitation	2004	2007	32.5	17.5	Loan	Korea	On-going	
Rehabilitation of Bridges along Main Trunk Roads	2005	2007		35.0	Grant	Japan	Under Tendering	NR-2: Takhnau Bridge (L = 100 m), Prek Ho Bridge (L = 75 m) BR-3 : Slakou Bridge (L = 100 m)
Rehabilitation of NR-7 (Kratie - Stugteng Lao Border)	2004	2007	187.0	50.0	Loan	China	On-going	PK334.5-PK521.2
GMS Cambodia Road Improvement (NR-5, 6 Siem Reap - Sisophone - Poipet) (ADB-1945)	2005	2008	145.0	77.5	Loan	ADB	Under Tendering	NR-5 (PK98-PK145) NR-6 (PK0-PK98) NR-56 and NR-68 : 39 bridges and 20 box culvert
Provincial and Rural Infrastructure Project	2004	2007	105.4	16.6	Loan	WB	On-going	(Siem Reap) NR-65 : L = 19.9 km NR-66 : L = 11.0 km PR-207 : L = 11.8 km (Oddar Meanchery) PR-181 : L = 28.7 km (Kampong Thom) NR-71 : L = 15.5 km (Preah Vihear) PR-213 : L = 18.5 km
Road Improvement of NR-48 (DBST Pavement)	2005	2008	152.2	21.7	Loan	Thai	Expected to start 2005	Thai and Cambodia Fund
4 Bridge Construction on NR-48	2005	2007		8.0	Grant	Thai	Expected to start 2005	Total Length : 1,560 m
Rehabilitation of NR67 (Siamreap - Anlong Veng - Sagnam)	2005	2007	123.7	27.8	Loan	Thai	Expected to start 2005	Siem Reap -Anlong Veng
NR-51 Road Rehabilitation Project	2003	2005	38.0	10.0	Loan / Grant	WB / Japan	Completed	Odong - Thnal Totoeang
Road Upgrading for SRN No.64	2005	2006	134.0		Loan	WB	On-going	NR-6 to Thailand Border
NR-4 Construction Project		1996	213.0			US Aid	Completed	Chaom Chau to Sihanoukville
Transport Infrastructure Development and Maintenance	2006	2010	91.0	un-known	Loan	ADB	TA On-going	NR-33: L = 12 km (Kamong Track - VN border) NR-68: L = 79 km (Kralanh - Thai border)

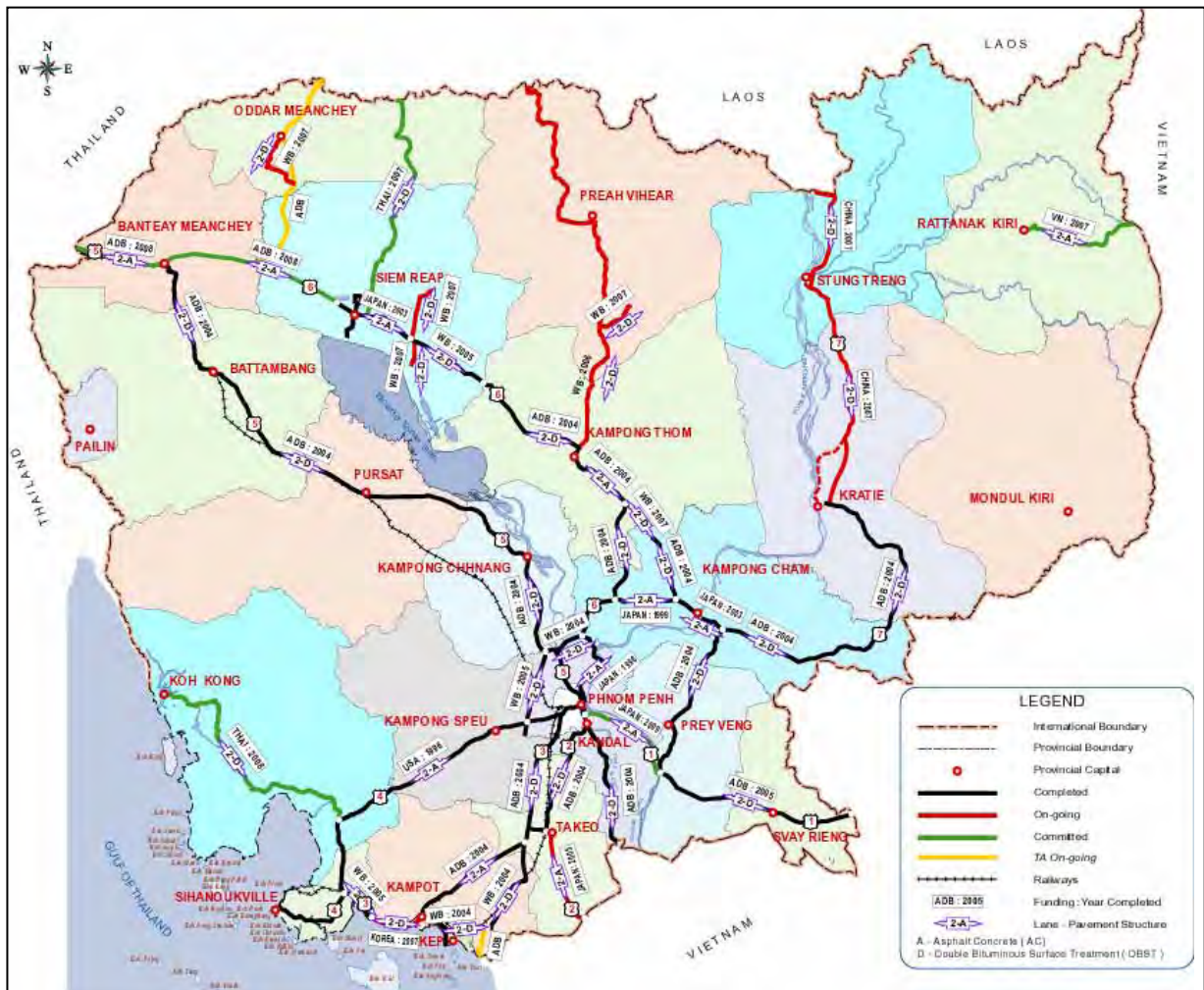


Figure 4.2.1 Major Road Projects in Cambodia

Funding institutions and donor countries contributing to the improvement of Cambodian national road network system includes the Asian Development Bank (ADB), World Bank (WB), United States, Japan, China, Korea, Thailand and Vietnam (see Figure 4.2.2). As seen in Figure 4.2.2, ADB contributed to about 40% of the total road length improvement along the national highways.

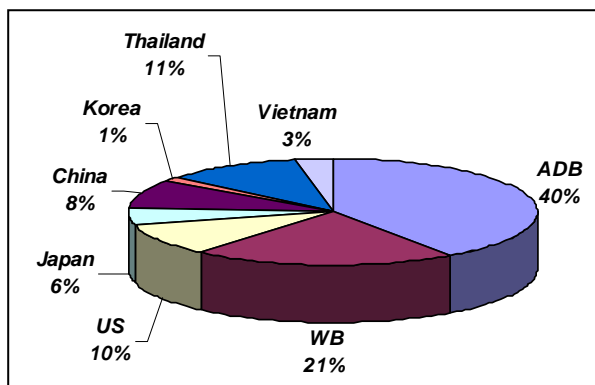


Figure 4.2.2 Funding Sources of Major Road Projects

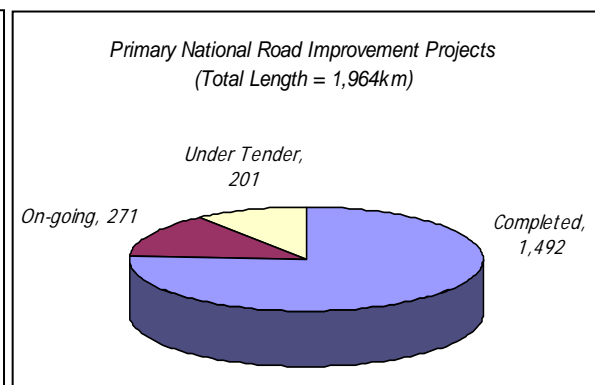


Figure 4.2.3 Status of 1-Digit National Road Projects

1-Digit National Road improvement/upgrading covers about 1,964kms, of which 1,492kms have been completed while 271kms are undergoing construction and 201kms under tendering stage (see **Figure 4.2.3**). On the other hand, about 996kms of the 2-Digit National Roads improvement are either completed or programmed to start.

The implementation schedule of major national road projects is presented in **Figure 4.2.4**. It is seen in the figure that by year 2008 almost 98% of improvement works for national roads NR.1 to NR.7 will be completed, except NR.1 section from Phnom Penh to Neak Loeng which will be completed by 2010.

Other national road improvements are still on project announcement status which includes NR.33, NR.56, NR.68 and NR.72.

**IMPLEMENTATION SCHEDULE OF MAJOR ROAD IMPROVEMENT PROJECTS**

National Road Number	Donor	YEAR											Total Road Length(km)					
		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006		2007	2008	2009	2010	
NR1	ADB, Japan							105 KM									56 KM	166.6
NR2	ADB, Japan							63 KM			51.6 KM							120.1
NR3	WB, Japan, Korea							169.5 KM				32.8 KM						202.3
NR4	USA	214.2 KM																214.2
NR5	ADB							358.6 KM									47.2 KM	405.8
NR6	Japan, ADB, WB							317.5 KM									98.2 KM	415.7
NR7	Japan, ADB, China							259.3 KM									192.8 KM	452.1
NR11	ADB							90.4 KM										90.4
NR21	ADB							77.5 KM										77.5
NR31	WB							51.7 KM										51.7
NR33	WB,ADB							39.8 KM									11.9 KM	51.7
NR48	Thailand																152 KM	163.3
NR51	WB							38 KM										38.0
NR62(NR64)	WB																134 KM	134.0
NR65	WB																19.9 KM	21.5
NR66	WB																11 KM	334.9
NR64(NR67)	Thailand																123.7 KM	123.7
NR71	ADB, WB							33.6 KM									15.5 KM	57.6
NR68	ADB																79 KM	117.7

\*Road number in parenthesis ( ) is old road number

**Figure 4.2.4 Major Road Improvement Projects Implementation Schedule**