

CHAPTER 1 INTRODUCTION

1.1 Project Background

Cambodia covers about 181,035 sq. km, and is bordered by Thailand, Lao PDR and Viet Nam. Its total population is estimated at approximately 9.3 million in 1995.

The Kingdom of Cambodia declared its independence in November 1953, and peace prevailed under the reign of the Prince Norodom Sihanouk until 1970. However, ever since the breakout of civil war in 1970, Cambodia has severely suffered from activity of its economy and society to an extent that major infrastructures and agricultural production facilities coupled with industrial facilities could not function properly. On 23 October 1991, at the meeting of the Paris Conference of Cambodia, the Agreement on a Comprehensive Settlement was signed to restore the country. The Government of Cambodia established development plans for the medium-term such as the First Five-year Plan (1985-1990) and the Second Five-year Plan (1990-1995). The long-term plan has also been prepared targeting developments in the next century.

According to MPWT's official list of March 1994, there are 4,164 km of national roads and 3,165 km of provincial roads. These national roads of 2,400 km length were paved before the war, and much of the road network was destroyed during the civil war.

The national road network is mainly composed as follows: an east-west corridor composing Routes 1, 5, and 6 from the Vietnamese border to the Thai border, and a north-south corridor consisting of Routes 2,3,4 and 7 from the Lao border to Sihanoukville.

Considering these badly deteriorated road conditions in Cambodia, the World Bank's 1994 Report at the conference of International Committee on the Reconstruction of Cambodia pointed out several urgent items to the transport sector: (1) to repair and rehabilitate the most dilapidated sections of the primary road network and to provide essential equipment and material for operations and maintenance of transport services, and (2) to expand the repair and rehabilitation of rural roads.

Several reconstruction implementation programs for the road transportation sector have been set up in order to reconstruct the economy of Cambodia, financed by many foreign donors. The Government of Japan also implemented the restoration of Chroy Changwar Bridge and rehabilitation works of Route 6. Although many rehabilitation works for the road network will be executed in line with the effort of the Government of Cambodia together with the financial cooperation by foreign countries or international agencies, there will still remain crucial issue; namely Cambodia is almost divided into two parts by the Mekong River without a bridge connecting the two sides. The Mekong River, which originates in the Tibetan Highlands and runs into the South China Sea with a catchment area of 795,000 sq. km and a water course length of 4,200 km, distinctly cuts the territory of Cambodia into a west side and an east side. This separation surely hinders Cambodia from current and future economic and social activities. At present crossing measures over the Mekong River depends on ferry facilities operated by MPWT at Neak Loeung on Route 1 and Kompong Cham on Route 7, and operated by the private sector at several points. As the east side of the Mekong River has an

abundance of agricultural products, the Government of Cambodia wishes the two sides to be linked by bridge for the sake of restoration of the economy.

1.2 Study Background and Objectives

Recognizing the importance of the construction of the Mekong Bridge (the Project), the Kingdom of Cambodia requested the Government of Japan to provide assistance for a feasibility study on the Project. In response to this request, the Government of Japan decided to conduct the Feasibility Study on Construction of Mekong Bridge in the Kingdom of Cambodia (the Study) in accordance with the relevant laws and regulations in force in Japan, and entrusted it to the Japan International Cooperation Agency (JICA), the official agency responsible for implementation of the technical cooperation program of the Government of Japan.

JICA dispatched a preliminary study team headed by Mr. Hiroo Jin to Cambodia from 27 November 1994 to 9 December 1994. The arrangement on the Scope of Work (Appendix 1.1) was signed between Ministry of Public Works and Transport (hereinafter called "MPWT") and JICA on 7 December 1994. Subsequently JICA organized an advisory committee and a study team in March 1995 to conduct the Study. The Study Team was then dispatched to Cambodia on 31 March 1995.

The principal objectives of the Study are to conduct the feasibility study on construction of the Mekong Bridge including its approaches. The study shall cover the areas as follows;

- (1) Neak Loeung
- (2) Prek Tamak
- (3) Kompong Cham

1.3 Scope of the Study

In order to achieve the objectives mentioned in Section 1.2, the Study covers the following items:

1. Data collection and analysis
 - (1) Socio-Economic Data
 - (2) Traffic and transport Data
 - (3) Soil and Geological Data
 - (4) Climate and Seismic Data
 - (5) Hydrological Data

- (6) Topographic Data
- (7) Development Plans
- (8) Others
2. Site Survey
 - (1) Traffic survey
 - (2) Topographic survey
 - (3) Soil and geological survey
 - (4) Hydrological survey
 - (5) Land use survey
 - (6) Other necessary survey
3. Traffic Forecast
 - (1) Forecast of future socio-economic framework
 - (2) Forecast of future traffic demand
4. Preliminary Comparative Study of alternatives at 3 Locations
 - (1) Routes
 - (2) Location
5. Evaluation of Alternatives in terms of above mentioned aspects
6. Comparative Study of Alternatives at Location
 - (1) Cost aspect
 - (2) Function aspect
 - (3) Engineering aspect
 - (4) Traffic accident aspect
 - (5) Construction aspect
 - (6) Maintenance Cost aspect
 - (7) Aesthetic aspect
7. Evaluation of Alternatives in terms of above mentioned aspects

8. Preliminary Design
 - (1) Design Criteria
 - (2) Bridge Design
 - (3) Approach Road Design
 - (4) Quantity Estimate
9. Planning and Scheduling of Construction Works
10. Maintenance Programme
11. Cost Estimate
12. Environmental Impact Assessment
 - (1) Socio-Economic Environment
 - (2) Natural Environment
 - (3) Environmental pollution
13. Economic and Financial Evaluation
14. Implementation program
15. Conclusion and Recommendations

The flow chart of the work program and the interrelations of the above mentioned work items are depicted in Figure 1.1.

1.4 Country Profile

1.4.1 General

Following many years of conflict Cambodia is now in a position where it will dedicate its resources and energy to sustained and equitable development. While progress has been made in recent years, much is still to be done with assistance continuing to be required, from the international community for some years.

In developing strategies policy makers will need to take stock of available human and natural resources and also recognize that, during the period of conflict, living standards and social indicators have declined, sensitive ecological balances have been destroyed, forests have been severely damaged and significant areas of arable land have been turned into minefields.

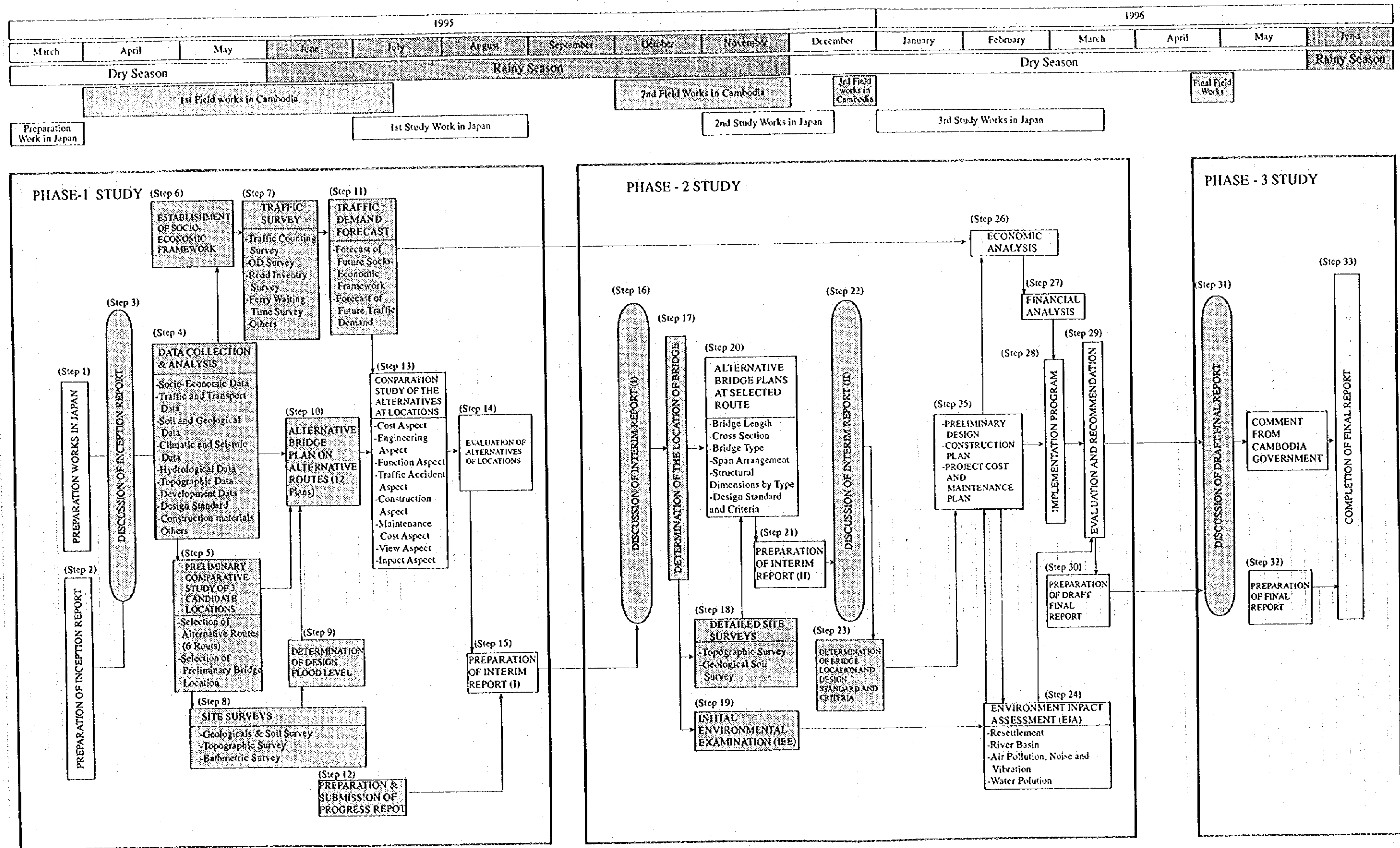


Figure 1.1 FLOW DIAGRAM OF FEASIBILITY STUDY ON CONSTRUCTION OF MEKONG BRIDGE

1.4.2 Physical and Climatic Characteristics

Cambodia has an area of 181,035 km² and consists of a central plain that is surrounded on three sides by forested and sparsely populated highlands. This plain is cut by the Mekong and the Bassac rivers, both flowing in a south and southeasterly direction, entering the South China sea via the delta in Vietnam. Of equal importance, is the Tonle Sap which joins the Mekong at Phnom Penh, and links it with the Tonle Sap Lake, that acts as a buffer for the Mekong River floods.

The climate in Cambodia is tropical monsoonal with an average rainfall between 1000 and 1500 mm with falls exceeding 3000 mm, along the southwest coast. Temperatures are fairly uniform with small variations from the annual mean of 25°C (10 to 38°C).

1.4.3 Natural Resources

Cambodia has a large forested area with nearly 60% (10.3 million ha) of its land area still under forest cover. High levels of deforestation in the last 30 years have however lead to the complete loss of forests in 6 provinces, which is leading to extensive erosion and a shortage of firewood in these provinces. FAO reports indicate that of the total area 4.4 million ha are untouched, 1.8 million ha are over logged and 4.1 million ha are open dry deciduous forests. These latter forests with their unique wildlife and bio diversity are the largest undisturbed area on the Asia continent and are amongst the last in the world.

The Tonle Sap lake which is rich in nutrients and had 16 varieties of fish was once the richest fishing lake in the world with fish being exported in significant quantities. This has changed in recent years with the sediment build-up, due to deforestation, resulting in a substantial decline in yields.

There is little mineral commercial resource exploitation at present and the prospect for most minerals is limited, except for gemstone and gold, although past studies indicated that there was some promise for oil and gas, and possible bauxite and gold.

1.4.4 Human Resources

Available data indicates a population of 9.3 million in 1995 (88% in rural areas), growing at an annual rate of 2.5 to 3.0 percent. Of this number 63% are women, half of whom are the heads of households. They also represent 70% of the total rural labor force, of whom half are under 15 years of age.

The current life expectancy of 49.7 years, the lowest figure in Asian, is due to poverty linked diseases whose control and prevention are widely known.

Education, especially primary education has been a high priority activity for a least 15 years. This has resulted in a literacy rate of approximately 70%, although this varies.

1.4.5 Growth Potential and Constraints

Since 1989 the country has opted for a policy that has opened the door to foreign assistance and given encouragement to private foreign investment. The authorities are

rapidly dismantling the old planning regime and reducing the impact of the state on production and consumption. The majority of the market has been liberalized, most prices freed, the scope of official subsidies significantly reduced and the official exchange rate has been decontrolled.

Extensive cultivable land area and a comparatively small population to support would suggest that Cambodia has the potential to develop a rich agricultural economy. Raising agricultural productivity and efficiency are clearly important objectives that will initially be achieved relatively quickly through the rehabilitation of the irrigation system, improved techniques and methods, and better crop and variety selection. Improved methods of distribution and marketing of produce, including highway upgrading, while taking longer must however be given high priority. Logging practices need to be reviewed to identify areas for sustainable logging, as should rubber production with a view to its rehabilitation, as both are a significant foreign exchange earner. These together with sugar, kenaf and bamboo (pulp processing) have markets that can be catered for through the rehabilitation of traditional agroindustries.

Cambodia is presently in a difficult period of transition that includes changes to the structure of the economy and an increasing demand on limited resources and services. The years ahead are therefore not likely to be easy with it being very difficult to maintain some control over the economy, while servicing the basic needs of the people.

1.5 Outline of the Report

Chapter 2 presents an overview of the transportation system in Cambodia, current transportation policies, and socioeconomic conditions. The main functions of a Mekong River Bridge are also discussed.

Candidate route and sites for this Project are explained in Chapter 3, including the results of road and bridge inventory survey relating to six candidate routes of a Mekong Bridge.

Chapter 4 highlights the current situation in the study area by presenting the results of surveys pertaining to road traffic, river-crossing ferry operation, and long-haul river transport operation. Furthermore, background information on potential development scenarios for Cambodia to be considered when forecasting future traffic is presented. This discussion is followed by an analysis of future traffic growth rates and estimated future traffic volumes on bridges at each potential location.

Chapter 5 outlines the findings of topographic, bathymetric, and geological surveys performed during the first assignment in Cambodia.

The river hydrological study of the Mekong River is presented in Chapter 6, which covers the general features of the Mekong River, hydrology, and river morphology.

In Chapter 7, preliminary plans of the bridge and road for the six candidate routes are studied, reviewing the evaluation of bridge plans at respective candidate bridge

locations together with study of drafts of preliminary bridge designs.

The initial environmental examination is presented in Chapter 8, which includes identification of environmental parameters, probable environmental impacts on the candidate sites and considerations on the optimum site selection.

Chapter 9 summarizes bridge and road construction cost estimates, maintenance costs, and total project costs at each of the six potential bridge sites.

In Chapter 10, overall evaluation of alternatives and bridge site are discussed for the purpose of recommending an optimum route among the six routes.

Chapter 11 elaborates on determination of selected route which focuses on fixing the route for the Study.

Chapter 12 presents the results executed during the second assignment regarding topographic, bathymetric and geological surveys.

In Chapter 13, results of study and considerations with respect to environmental impact assessment targeting on selected route are presented.

Chapter 14 details bridge plan comparison including approach road.

Chapter 15 presents cost estimates comprising of construction plan, project cost and maintenance cost.

Chapter 16 studies economic evaluation and financial evaluation.

In Chapter 17 the Implementation program is summarized, taking in account assumed progress of necessary activities prior to commencement of construction works.

Chapter 18 presents the final conclusion and recommendation of the Study.

1.6 Study Organization

JICA organized an Advisory Committee headed by Mr. Hiroo Jin to ensure proper execution, and a Study Team comprising ten specialists headed by Mr. Hisashi Ohshima of Nippon Koei Co., Ltd., Team Leader, to carry out the Study on the Feasibility Study on Construction of Mekong Bridge in the Kingdom of Cambodia. At the same time, Government of Cambodia set up a Steering Committee chaired by Mr. Tram Iv Tek, Secretary of State, Ministry of Public Works and Transport, in order to facilitate and ensure the smooth conduct of the Study.

Organization Chart is shown in Figure 1.2.

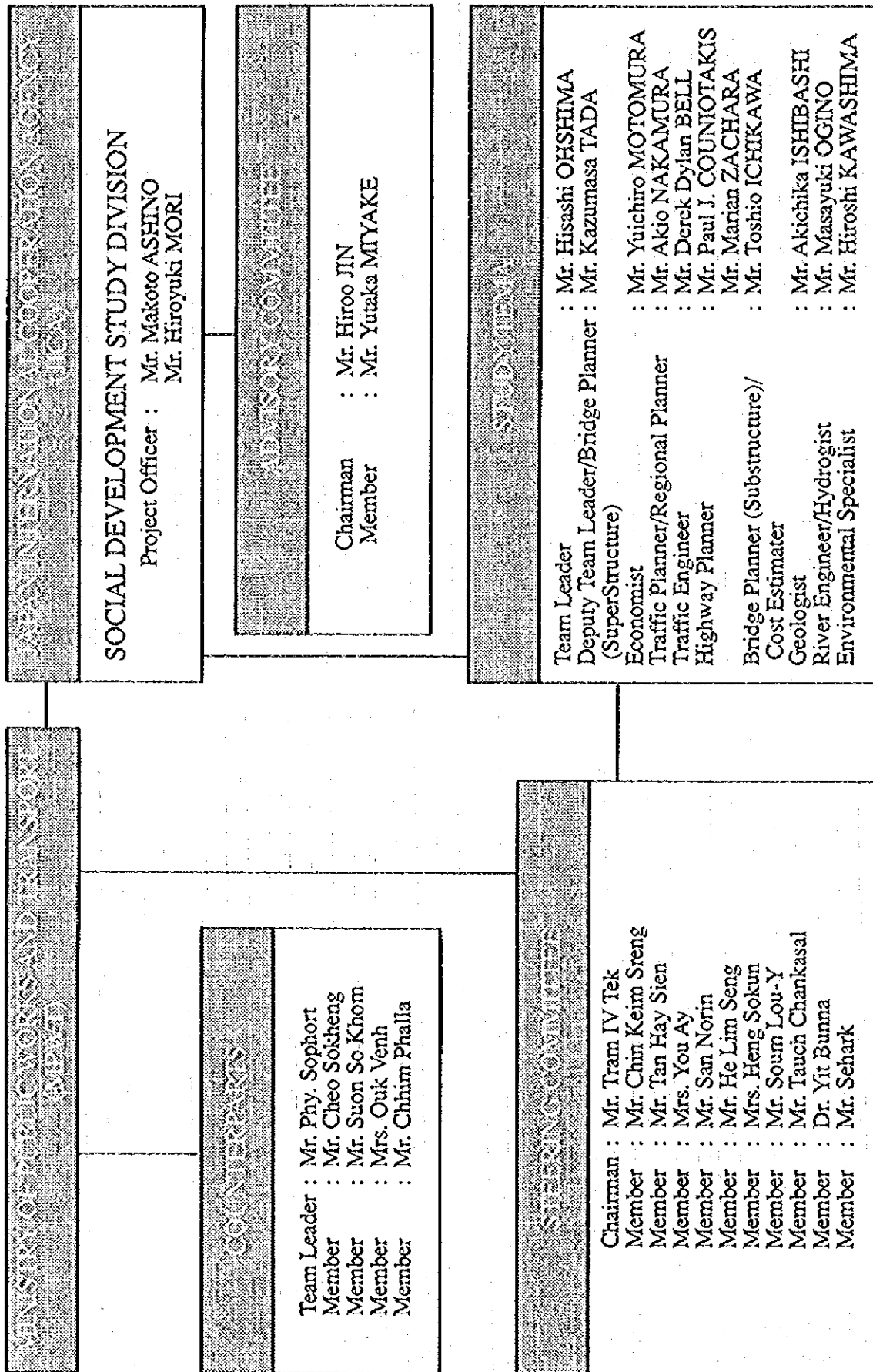
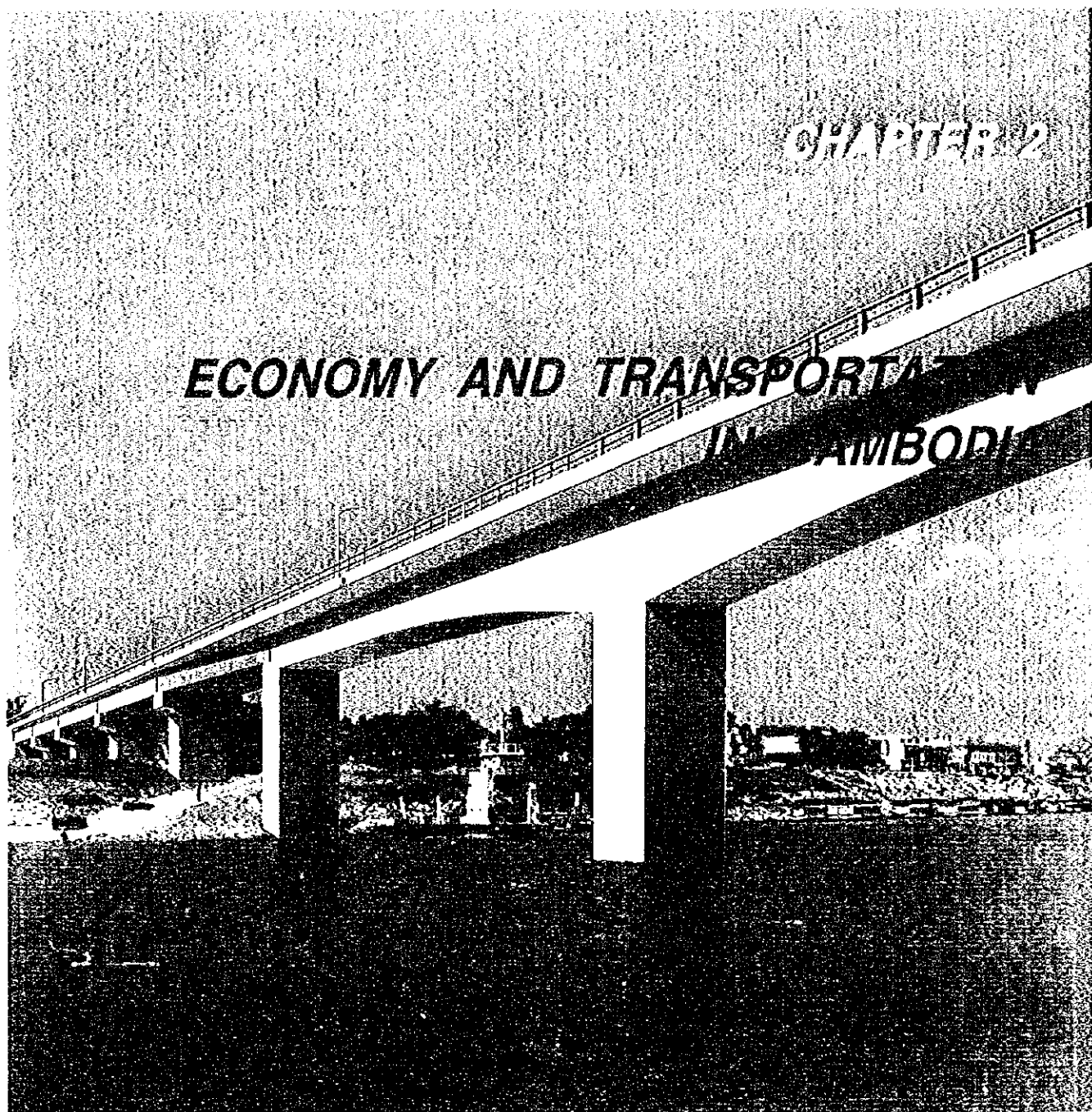


Figure 1.2 Organization Chart

1.7 Major Meetings Held

During the study period, the following meetings were held in Cambodia and the minutes of each meeting is attached in Appendix 1.2.

Meeting	Date	Main Subjects
First Steering Committee	April 6,1995	Inception Report
Second Steering Committee	July 8,1995	Progress Report
Third Steering Committee	October 5,1995	Interim Report(I)
Fourth Steering Committee	December 20,1995	Interim Report(II)
Fifth Steering Committee	April x, 1996	Draft Final Report



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CHAPTER 2 ECONOMY AND TRANSPORTATION IN CAMBODIA

2.1 Transportation in Cambodia

2.1.1 Roads

For the reconstruction of the country as a whole, a well-arranged road network is essential. Domestic and international markets for local produce can only be available at very high costs or not at all. Supply routes for essential commodities are severely restricted, and basic social services cannot be provided in the country's more isolated areas.

MPWT's official list of March 1994 includes 4,165 km of national roads and 3,165 km of provincial roads. Out of the total length of national roads 2,400 km was paved before the war. Much of the road network in Cambodia was destroyed by war activities during the 1970s.

The road network basically follows a radial pattern originating in Phnom Penh, and two transport corridors are noticeable: an east-west corridor comprising Routes 1, 5, and 6 from the Vietnamese border to the Thai border, and a north-south corridor consisting of Routes 2, 3, 4, and 7 from the Lao PDR border to Sihanoukville. All roads are cut off at Mekong River crossings throughout Cambodia.

Most of the main roads are in flat terrain; altitudes of Routes 1, 2, 3, 5, and 6 range from 1 m to 18 m. The widths of carriageways range from about 4.5 m to 6 m, and total road width is 9-10 m on many sections. However, shoulders in the normal sense of the word are rare. Almost all roads have uniformly the same type of pavement, namely a subbase of 15-20 cm selected laterite on a subgrade of more or less selected soil, a base course of 15 cm penetration macadam, and one layer of surface treatment. About 25% of the main roads in terms of total length has broken pavement exposing a mixture of macadam and laterite.

Throughout Cambodia roadside drainage systems are insufficient due to deterioration. However rehabilitation and repairs such as embankment construction, pothole patching, and resealing have already been applied to some portions of Routes 1, 2, and 5 funded by the Asian Development Bank (ADB). Road bridges are generally weak; two-thirds of bridges have an estimated safety load of less than 20 tons, restricting the safe passage of fully laden trucks. Some of the more seriously damaged bridges received temporary repairs by UNTAC and some were replaced.

2.1.2 Inland Waterways

Inland waterways consisting of the Mekong River, Bassac River, Tonle Sap Lake, and their tributaries are the major transport means in Cambodia.

Upstream from Phnom Penh, waterways of the Mekong River fall into three reaches, between Phnom Penh and Kompong Cham (105 km), between Kompong Cham and Kratie (116 km), and between Kratie and Stung Treng (120 km). Boats of up to 150-ton

capacity can be used as far as Kratie, up to 20 tons between Kratie and Stung Treng the whole year.

Because of the present badly damaged road conditions and security problems, the waterway upstream from Kratie is the only practical choice for north-south transportation.

Downstream from Phnom Penh, two waterways are utilized: one is via the Mekong River, and another is via the Bassac River. The waterway via the Mekong comprises two routes between the Vam Nau pass in Vietnam and the South China Sea.

The Mekong River route (102 km stretch within Cambodia) probably has a limitation of 7,000 dwt because of the bend of the river. During the high water season, the navigability of the Mekong River is increased.

2.1.3 Ports

There are two major ports in Cambodia: a river port in Phnom Penh connecting with the South China Sea via the Mekong and Bassac Rivers through the delta in Vietnam, and a sea port in Sihanoukville at the edge of the Gulf of Thailand.

Sihanoukville is the country's main deep-sea port. Boats of up to about 10,000 dwt can use the port due to the rocky outcrops in the channel. Containers are exclusively handled at Sihanoukville. The significance of Sihanoukville is gradually increasing for international shipping.

The Port of Phnom Penh is located in the central part of the capital city and some 330 km from the mouth of the Mekong. The capacity of vessels accessible to the Phnom Penh Port is strictly limited due to the shallow draft. Boats of up to 2,000 dwt can use the route without difficulty, and 5,000 dwt boats can travel when favorable tides come to the mouth of the Mekong. Oil and general cargo are handled at this port, which is situated in a geologically advantageous location.

2.2 Current Transportation Policies

2.2.1 Policies and Strategies

Basic principles for a road network plan together with a conceptual regional development plan are identified in the *National Programme to Rehabilitate and Develop Cambodia*. According to this Programme, the aims of establishing an efficient transport network are:

- to reduce fragmentation of the domestic market;
- to improve communications and stimulate private investment;
- to boost domestic and external trade, as well as promote closer links with neighboring countries;

- to integrate all rural areas into the mainstream economy;
- to improve living conditions; and
- to reduce the financial burden borne by the national budget.

Growth poles, development centers, and a growth corridor constituting a future spatial regional structure are also referred to in the Programme. The three growth poles are Phnom Penh, Sihanoukville, and Siem Riep, and the growth corridor is the belt between Phnom Penh and Sihanoukville. Further, community development centers are proposed for rural development in the following 10 areas: Kompong Cham, Prey Veng, Svay Rieng, Kratie, Takeo, Battambang, Banteay Meanchey, Kampot, Siem Riep, and Pursat.

For the development of these growth poles and corridors, the following priority projects in the transport sector have been identified:

- upgrading of domestic airline services and airports
- rehabilitation of Route 4 to Sihanoukville and Route 6 to Siem Riep.

2.2.2 Transport Plans

The projects to which the Cambodian Government attaches high priority for rapid implementation in the transport sector are also referred to in the *National Programme to Rehabilitate and Develop Cambodia*. These projects are the following:

- expansion and modernization of Pochentong Airport in Phnom Penh;
- modernization and dredging of the Sihanoukville and Phnom Penh ports;
- reconstruction of Routes 4, 6A, and coastal 3;
- rehabilitation of the worst sections of the primary road network, especially along Routes 1 (Phnom Penh-Neak Loeng), 5, 6 (Phnom Penh-Siem Riep), and 7, together with their associated bridges;
- construction of industrial estate and export-processing zones in Sihanoukville, and a study of the same in Phnom Penh; and
- repair of the rail track and bridges on both the Phnom Penh-Battambang and the Phnom Penh-Sihanoukville lines, and replacement of locomotive equipment, rolling stock, and associated telecommunication facilities.

As longer term objectives, in addition to restoration work, priorities with the following features are to be pursued:

- strengthening linkages with neighboring countries;
- upgrading the quality of domestic services; and

- expanding facilities in provincial and district areas in order to support rural economic and social advance.

Longer-term priorities concern:

- extending communication into the more remote areas of the country, but in ways that are sensitive to environmental and cultural pressures;
- upgrading the Cambodian sections of the Asian Highway, in particular, Routes 1 and 5 linking the Thai and Vietnamese networks and in addition, Routes 7/13 providing the Lao road network access to Sihanoukville Port and the sea;
- exploring other transborder initiatives to forge closer regional linkages and to expand regional markets, such as railway development and tourism; and
- upgrading and expanding the Sihanoukville Port and associated facilities to enable it to better handle containerized traffic.

Although the road improvement program proposed by the Cambodia Transport Rehabilitation Study (TRS) is not an officially approved national program, it is recognized by MPWT as a practical guideline to the Cambodian road program because this program included the consideration of likely budget constraints (Figure 2.1).

TRS proposed a staged road improvement program for the short (1995-99) and medium term (2000-2004), as outlined below:

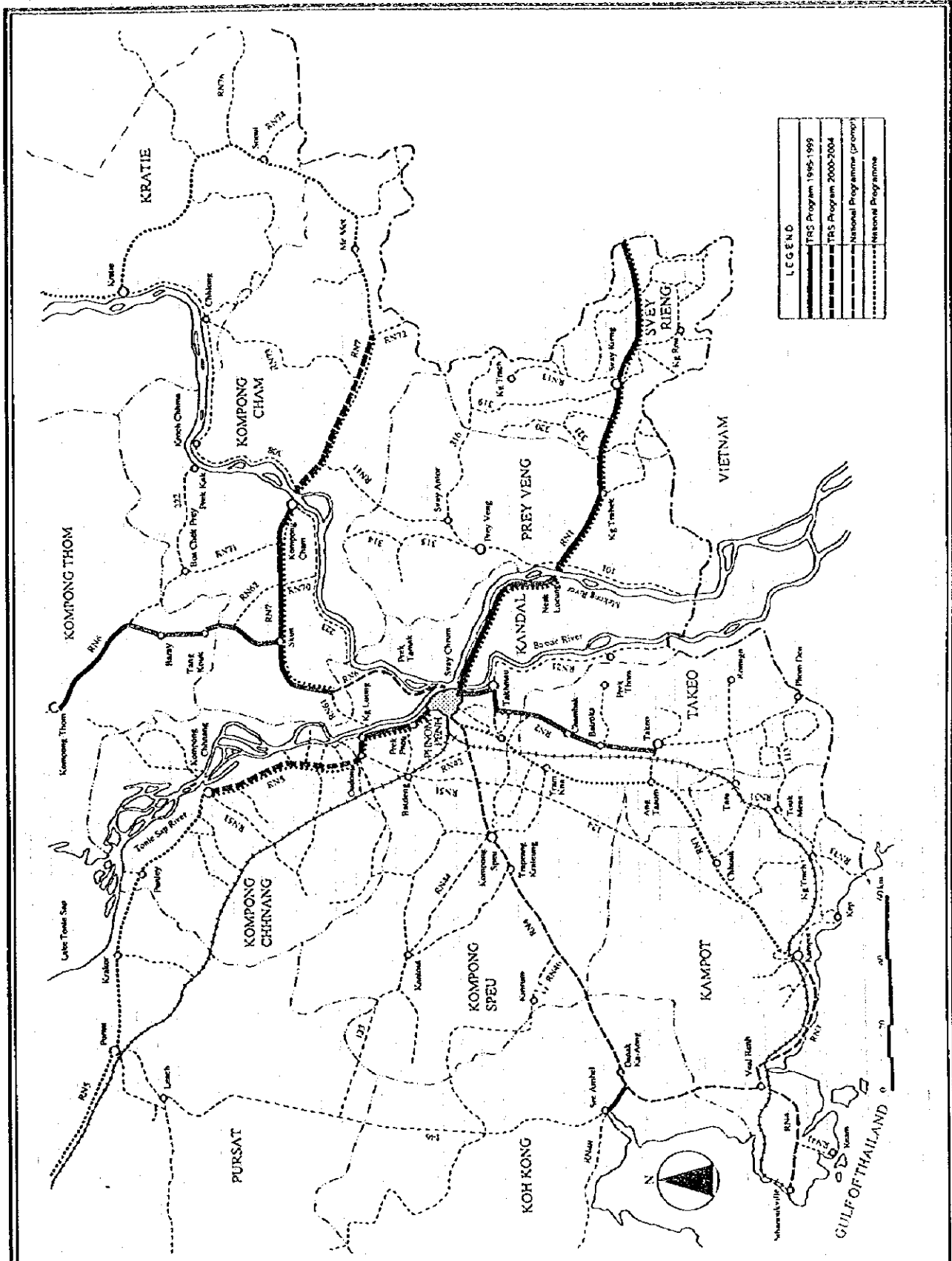
<1995-1999>

Route 1	(P.Penh-N.Loeung, N.Loeung-Vietnamese border)
Route 6	(Jct.6A-Skun, Skun-K.Thom)
Route 7	(Skun-K.Cham)
Route 2	(P.Penh-Takeo)
Route 5	(P.Penh-Odong)
Route 48	(P.Kong-Sre Ambel)

<2000-2004>

Route 5	(Odong-K.Chhnang)
Route 6	(K.Thom-S.Riep)
Route 7	(K.Cham-P.Krek)

As for the international road network, the *Economic Cooperation Programme in the Greater Mekong Subregion* was agreed upon in the fourth international conference held in Chiang Mai in 1994. This conference with ministerial level attendants of member countries was promoted by the Asian Development Bank for the promotion of economic cooperation among the six riparian countries in the Mekong River Basin. Road projects of each stage related to Cambodia are as follows:



LEGEND	
	TBS Program 1985-1989
	TBS Program 2000-2004
	National Programme (Group)
	National Programme

THE FEASIBILITY STUDY ON
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Figure 2.1
Road Improvement Plan
JAPAN INTERNATIONAL COOPERATION AGENCY

<First Tier (Immediate Implementation)>

R1 Bangkok-Phnom Penh-Ho Chi Minh-Vung Tau Road Project
(Routes 5 and 1)

<Second Tier (1994-2000)>

R6 Southern Laos-Sihanoukville Road Improvement Project
(Routes 4, 6, and 7)

R9 Northern Cambodia-Central Viet Nam Corridor Road Project
(Route 78)

The Neak Loeung ferry crossing is located on the road constituting the R1 project and the Kompong Cham ferry crossing on R6. Kompong Cham can also be considered to be on the influenced road by the R9 project.

Compared with the *Economic Cooperation Programme in the Greater Mekong Subregion*, the Asian Highway Network proposed by ESCAP has no clearly defined program or budgetary source. The following four routes were designated in the recently released report *Development of Asian Highway Network, ESCAP, 1994* (Figure 2.2):

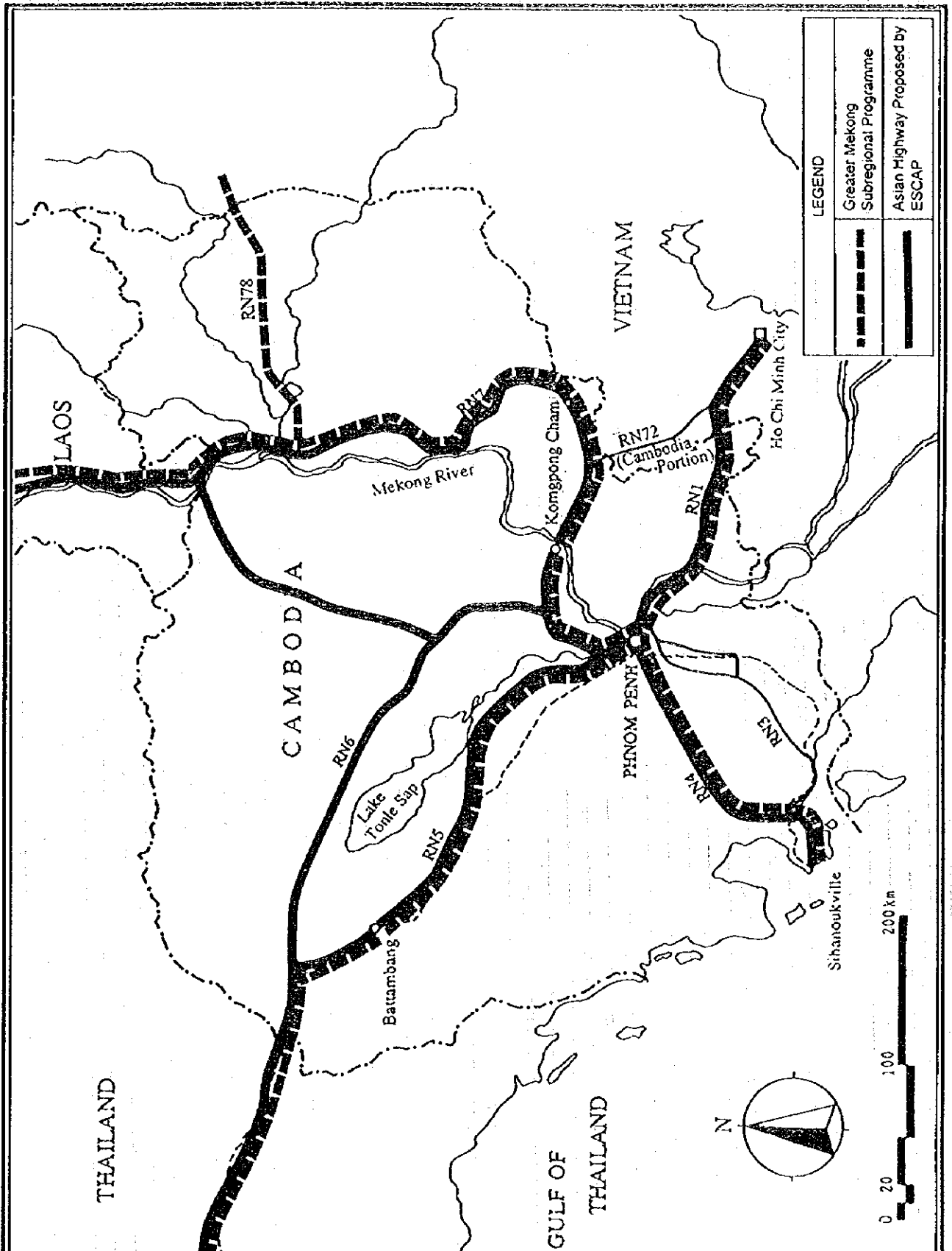
A - 1	574 km (Routes 5 and 1)
A - 11	761 km (Routes 4, 6, and 7)
A - 11a	215 km (Routes 64 and 213)
A - 13	341 km (Route 6)

2.2.3 Current Projects

MPWT's capability to fund or co-finance any major project is very limited because of its budget constraint of only 159 billion riel (about US\$ 69 mil.) for 1995. Most of the local funds are used for emergency repairs for different provincial roads. Larger projects are usually typically by foreign aid organizations.

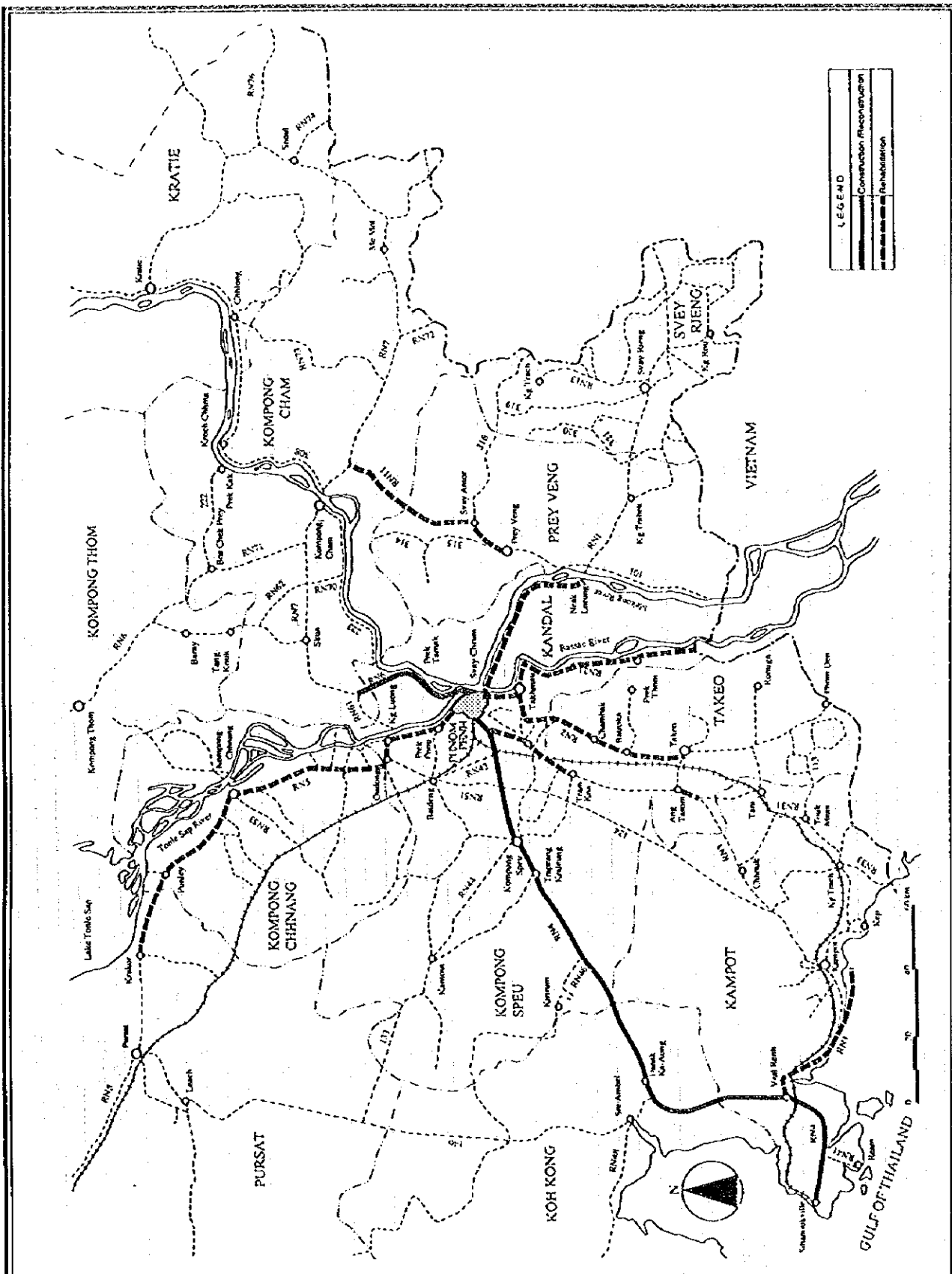
Among the foreign aid rehabilitation projects, ADB's Special Rehabilitation Assistance Project (SRAP) is the most extensive; it concerns emergency rehabilitation, i.e., the provision of critical equipment for roads, railways, and ports. The total budget is some US\$ 35 million excluding the cost of technical assistance. This project commenced in mid-1993 and is expected to continue until the end of 1996. The World Bank also has a multi-sector Emergency Rehabilitation Project. Several countries including Japan are committed as bilateral donors.

Current ongoing projects considered to be related to the Mekong River Bridge are described below (Figure 2.3).



THE FEASIBILITY STUDY ON
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Figure 2.2
Proposed International Roads
JAPAN INTERNATIONAL COOPERATION AGENCY



**THE FEASIBILITY STUDY ON
CONSTRUCTION OF THE MEKONG BRIDGE
IN KINGDOM OF CAMBODIA**

Figure 2.3
Current Road Project
JAPAN INTERNATIONAL COOPERATION AGENCY

(1) Roads and Bridges

Most of the projects are categorized as rehabilitation work.

Route 1	(1994-, 55 km, US\$ 1.5 mil. funded by SRAP)
Route 2	(between Jct.Route 1 and Takeo, US\$ 1.15 mil. funded by SRAP)
Route 3	(-1995, km0-45, between Kampot and Jct.Route 4, and other section, US\$ 0.9 mil. funded by SRAP)
Route 4	(1994-96, 214 km, reconstruction funded by USAID)
Route 5	(1992-96, 361 km, funded by UNDO/OPS and SRAP) Bridges were financed by AIDAB.
Route 6	(-1995, 45 km, reconstruction and construction funded by JICA; northward from Skun, funded by SRAP and financed by MPWT)
Route 11	(1995-, the northern section between Prey Veng and Route 7, US\$ 2 mil. funded by SRAP)
Route 21	(1994-, 76 km, US\$ 3 mil. funded by MPWT)

A Bridge Replacement Project financed by AIDAB is estimated to include the order of 1,000 meters of bridges along the main roads during 1995-97. The tentative program focuses on Route 5 plus a few bridges along Routes 1, 2, and 6.

(2) Ferries

A ferry project funded by DANIDA was launched in 1995 and is expected to be completed in 1997, aiming at improving the operational reliability of ferries, preventing rapid deterioration of ferries, and improving the efficiency and safety of terminal operations.

In this project, improvement of four ferry crossings is planned; they are Neak Loeung, Kompong Cham, and Stung Treng on the Mekong River and Prek Kdam on the Sap River. The contents of improvement work are as follows:

Neak Loeung:

- Extension, repair and improvement of existing movable steel jetties with hauling system;
- River bank protection;
- Reconstruction of the lower part of existing concrete ramp; and
- Construction of a new slipway;

Kompong Cham:

- Extension of existing concrete ramps;
- Dredging of 1,000 cu.m.;

- Scour protection; and
- Installation of two new movable jetties incl. hauling system.

In this project, the provision of two ferries (Prek Kdam and Neak Loeung) and rehabilitation of three existing ferries (Kompong Cham and Neak Loeung) are also stipulated.

The cost of reconstruction and rehabilitation of these ferries is estimated at US\$ 11.9 million. Improvement of landing facilities at four ferry crossings is estimated to cost US\$ 2.2 million. The total project cost is estimated at US\$ 17.2 million.

Item	Cost (mil. US\$)
vessels	11.9
civil works	2.2
equipment and materials	0.3
administration	1.1
contingencies	1.6
total	17.2

Construction of the Mekong River Bridge and improvement of ferry crossings at Neak Loeung and Kompong Cham are mutually competitive. According to the MPWT, if one of these two locations is chosen for the Mekong Bridge the ferry boats will be moved elsewhere.

2.3 Socioeconomic Situation

2.3.1 Present Situation

(1) Population

Possibly the most reliable population estimates are provided by UNTAC, which conducted surveys in early 1993 in order to register voters for the election on a systematic and coherent basis.

The total population, including most of the refugees returning to the country, was slightly over 8.8 million. The overall population growth rate is generally estimated around 2.5% p.a.

The distribution of the population is concentrated in (a) six provinces located in the central plains and around the capital, which contain close to 60% of the total population; (b) the provinces of Battambang and Banteay Meanchey, where over the 10% of the total population resides; and (c) Svay Rieng Province.

In contrast, other provinces and in particular Ratanakiri and Monduliri, which are not easily accessible due to the lack of road infrastructure, are very sparsely populated (Table 2.1 and 2.2).

Table 2.1 Population in Cambodia

Year	Population (millions)	Growth Rate
1981	6.68	-
1988	8.11	-
1989	8.33	2.7%
1990	8.57	2.9%
1991	8.81	2.8%
1992	9.26 *1	5.1% *2
1993	9.65 *1	4.1% *2
1994	9.89	2.5%

Source: National Institute of Statistics, Ministry of Planning

Note: *1 Figures include repatriated population of about 375,000

*2 Growth rates excluding the repatriated population were 2.2% in 1992 and 2.4% in 1993.

According to UNICEF and the World Bank, the urban population in 1992 represented about 12% of the total and grew at 3.9% p.a. between 1980 and 1992. The Cambodian population is young, at least half of the population is under 18 years old.

(2) Economy in General

Cambodia is now undergoing a difficult transition from a command to a market economy. A broad economic reform program was launched in 1989.

Overall GDP expanded at an annual rate of 6% over the 1991-1994 period. GNP per capita grew from about US\$ 130 in 1990 to around US\$ 200 in 1992. These upward trends are mainly due to the accelerated process of liberalization since 1989.

Agriculture contributes close to half of real GDP, followed by trade, non-governmental services, and construction, while the share of manufacturing is only about 7% of real output. Agriculture employs the largest proportion of the labor force (80%), followed by services and construction (15%), and manufacturing.

Although these relatively strong economic activities imply that the conditions for expansion in output are reasonably good, the present growth is unbalanced. Much of this growth has been concentrated in Phnom Penh. Solid growth in services, construction, and manufacturing has been observed. Meanwhile in the agricultural sector no outstanding growth is taking place (Table 2.3). In fact, the agricultural productivity of Cambodia (e.g., tons of rice per hectare) is currently less than half that of Vietnam and Thailand.

Table 2.2 Population Growth Rates and Density by Region in Cambodia

Region	Land Area (sq.km)	Population in Thousand Persons		Avg. Annual Growth Rate (%)	Density in 1993
		1981	1993	1981-1993	(persons/sq. km)
Total	181035	6682	8823	2.3%	49
I. Plain Region	25069	3613	4789	2.4%	191
Phnom Penh	267	329	668	6.1%	2501
Kandal	3591	720	842	1.3%	234
Kompong Cham	9799	1070	1346	1.9%	137
Svay Rieng	2966	292	416	3.0%	140
Prey Veng	4883	672	881	2.3%	181
Takeo	3563	530	636	1.5%	179
II. Tonle Sap Lake Region	67668	1971	2507	2.0%	37
Kompong Thom	13814	379	470	1.8%	34
Siem Riep	15271	477	555	1.8%	36
Banteay Meanchey	9937	-	390	-	39
Battambang	10433	719	534	1.8%	51
Pursat	12692	175	255	3.2%	20
Kompong Chhnang	5521	221	304	2.7%	55
III. Coastal Region	17237	432	631	3.2%	37
Sihanoukville	868	53	107	6.0%	123
Kampot	5209	354	454	2.1%	87
Koh Kong	11160	25	70	8.9%	6
IV. Plateau and Mountain Region	68061	666	896	2.5%	13
Kompong Speu	7017	340	465	2.7%	66
Preah Vihear	13788	69	86	1.9%	6
Ratanakiri	10782	45	67	3.3%	6
Stung Treng	11092	39	64	4.1%	6
Mondulkiri	14288	16	21	2.5%	2
Kratie	11094	157	193	1.7%	17

Source: 1981; National Institute of Statistics, Ministry of Planning
1993; UNTAC's record the registered voters in 1993 (Ministry of Planning)

Note: *1; Including 3000 sq. km of Tonle Sap area

*2; Banteay Meanchey was created in 1988 from 5 districts of Battambang and 3 districts of Siem Riep.

*3; Avg. annual population growth rates of Battambang and Siem Riep were estimated using total population of Battambang, Banteay Meanchey and Siem Riep.

**Table 2.3 Gross Domestic Product by Industrial Origin at 1989
Constant Prices**

	(Bil. riels)					
	1989	1990	1991	1992	1993	1994 (Est.)
Gross Domestic Product	240.9	243.7	262.2	280.6	291.6	306.8
Agriculture	125.9	127.4	135.9	138.5	135.7	137.6
Crops & Rubber	78.2	74.0	79.3	79.0	74.6	70.3
Rice	51.1	49.6	47.6	46.7	44.1	39.2
Other Crops & Rubber	27.1	24.4	31.7	32.3	30.5	31.1
Livestock	32.3	34.1	34.5	36.9	39.2	40.4
Fishing	9.4	12.4	13.5	12.7	12.0	12.0
Forestry	6.0	6.9	8.6	9.9	9.9	14.9
Industry	37.1	36.3	39.5	45.7	52.6	60.1
Mining and Quarrying	2.5	2.8	3.0	3.2	3.4	3.6
Manufacturing	18.0	17.2	18.4	19.0	20.5	22.1
Electricity & Water	0.6	0.5	0.5	0.6	0.7	0.7
Construction	16.0	15.8	17.6	22.9	28.0	33.6
Services	77.9	80.0	86.8	96.4	103.3	109.1
Transport & Communications	6.5	6.4	7.0	8.1	8.9	9.3
Wholesale & Retail Trade	31.2	30.5	34.4	39.9	42.3	44.8
Hotels & Restaurants	0.4	0.7	1.0	1.3	1.4	1.5
Government Administration, Education & Health	9.3	11.0	11.0	11.0	11.5	11.8
Home Ownership	15.5	15.9	16.3	17.4	18.8	20.2
Other Services	15.0	15.5	17.1	18.8	20.4	21.5

Source: Cambodian authorities and World Bank/IMF estimates

(3) Budget

The 1994 national budget was US\$ 405 million. Current expenditure accounts for 65% of the budget, against 35% for capital expenditure which will be financed in large part (almost 90%) with external resources. The Ministry of Public Works and Transport receives about 19% of the total budget in order to implement a large-scale public investment program, financed predominantly by external aid organizations, to rehabilitate transport infrastructure. The government suffers from budget deficit, and reduction of budget deficit and fiscal consolidation are the central themes of the new program.

The Government intends to increase, with external aid, public investment from 14% of GDP in 1993 to 20% in 1996, concentrating on the key sectors of health, education, agriculture, transport, and communications.

(4) Income and Prices

Unemployment and underemployment are high but no estimate of the scale of these problems has been attempted.

The Socio-Economic Survey in Cambodia-1993/4 sponsored by ADB and UNDP revealed that the average monthly household expenditure is US\$ 125 in Cambodia and US\$ 357 in Phnom Penh. Considering the average household size and number of income earners per household, the average monthly expenditure of income earners is estimated around US\$ 100 in Phnom Penh and US\$ 45 in Cambodia.

Data supplied by the National Bank of Cambodia show that consumer prices rose steeply from 1989 to 1993 with an average inflation rate of over 150%; however this unstable situation has settled down with an inflation rate in the previous year of minus 28.4 % (i.e., deflation).

(5) Structure of Economy

(a) Agriculture

Agriculture is the most dominant sector of the Cambodian economy, accounting in 1993 for 46.5% of real GDP and around 80% of total employment. According to the Cambodian authorities and World Bank/IMF estimates, crops contribute 55% to agricultural GDP of which rice accounts for 33 % while live stock, fisheries, and forestry contribute 29%, 9%, and 7% respectively. However, the share of forestry appears grossly underestimated.

The survey results show that the cultivated area accounts for 22% of the total area of the country. Forest occupied 62% of the total land area in 1992. Paddy fields dominating in cultivated land are about 2.6 million ha, compared with about 230,000 ha for other crops including rubber. In 1967 rice was reported to occupy more than 2.5 million ha, and other crops about 319,000 ha. Rubber and maize are the most important crops other than rice. Other secondary crops include mungbeans, tobacco, soya bean, cassava, sweet potato, and sesame. Vegetable production is extensively developed all along the Mekong River. Great regional diversity is observed in the country's agriculture.

The increase in the area of root crops (sweet potato, cassava) rose from 3,500 ha in 1967 to 26,000 ha in 1993. The steady rise in rice yields from 1 ton/ha. in the 1967 to 1.3 ton/ha. in 1993 (yet still far short of Thailand's 3+ tons/ha.), enabled the country's food supply to keep pace with population growth. In 1993 the deficit in white rice was officially estimated at 257,000 tons. However, it is difficult to assess the actual deficit, because of the lack of information on the quantities of rice known to be exported informally to Thailand and Vietnam. According to the report by FAO, the production level of rice in Cambodia is estimated slightly above self-sufficiency level.

The livestock production in Cambodia has not yet been based on the large commercial production system like other countries of Southeast Asia such as Thailand.

Household producers breed and raise pigs and poultry with very small numbers of animals within the local economy. Cattle and buffalo still provide almost all the draught power for cultivation and a substantial proportion of the power used for the haulage of farm produce. Given the current low level of productivity in this sub-sector, it should be possible through the improvement of road transport/infrastructure to achieve substantial improvements in the level and efficiency of production. The present low production efficiency level of the livestock sub-sector is due to the lack of effective support systems for disease and a poorly developed infrastructure for the supply of animal feed and other inputs and delivery of goods to markets.

Regarding forestry, large stocks of teak and rosewood are the most valuable in the country. Proper development of this sub-sector is also essential for stability in wet-rice cultivation and fish production.

In 1969, topographical surveys revealed that 13.2 mil. ha was covered with forest accounting for 73% of Cambodia. In 1989, the Mekong Secretariat undertook a landuse reconnaissance survey of the country using Landsat satellite imagery. Their findings suggest that the forest cover is 11.2 mil. ha, meaning that 2 mil. ha of forest have been lost over the last 20 years (100,000 ha/year), and that the forest cover has been reduced from 73% to around 65%.

In 1991, authorized cutting was 350,000 cu.m, and illegal and private cutting of timber was estimated at 450,000 cu.m; in areas bordering Thailand cutting was estimated at 350,000 cu.m. Therefore, cutting in 1991 almost exceeded 1 mil. cu.m. excluding fuelwood estimated 4 mil. cu.m. Given a good forest management program, it would appear to be well within the sustainable capacity of the forest to produce. However the lack of management probably means that severe localized overcutting is occurring, and this situation seriously threatens the life of the forest.

The average price per cu.m for logs paid by the principal importers was US\$ 70; for cut timber the price was US\$ 200 in 1992.

In 1995, the Ministry of Agriculture announced a new ban on the export of logs and sawn timber from the country's dwindling forest reserves.

(b) Industry

Industrial value added remains at a relatively low 19% of GDP, although it is growing at a more rapid pace than agriculture.

In the manufacturing sector, food processing industries dominate with a share of 43%, followed by textiles/garments industries, chemical industries, engineering industry, various light industries, and construction materials.

The present government has embarked upon a comprehensive privatization program. Many former large Government enterprises underwent changes in ownership and/or management. The bulk of industrial establishments is accounted for by private cottage and small-scale industries.

In rural areas more than one thousand rice mills are in operation. In the towns there are factories producing various light consumer goods.

The absence or shortage of domestically produced consumer goods has given rise to lucrative cross-border trading with Thailand and Singapore (by sea).

The construction sector has been currently expanding largely due to UNTAC, successive UN agencies, and bilateral donors. Since the departure of UNTAC, aid programs continue to contribute to solid growth in construction, mainly in Phnom Penh.

Mining activities are minimal in Cambodia. Extraction is performed on a very small scale with the exception of gemstones (Pailin mine) and gold; the exploitation of most minerals has now reverted to artisanal methods and goes largely unreported. The only mineral exploitation on any significant scale is that of oil and gas.

Deposits of phosphates are located in the southern provinces of Kampot and are processed in plants located in Battambang and in Kampot for use as fertilizers. Approximately 50,000 tons per year have been produced since 1988.

(c) Services

The service sector has shown rapid growth over the last several years with an average growth rate of around 8% p.a. accounting for about 35% of GDP. The service sector is heavily concentrated in trading activities (15% of GDP) and in catering-related services.

2.3.2 Socioeconomic Policy

The Cambodian Government submitted its *National Programme to Rehabilitate and Develop Cambodia* to the Second International Committee on the Reconstruction of Cambodia, held in Tokyo in March 1994. This document clearly identified the Cambodian Government's strategies for rehabilitation and development and its priorities for both the medium term (3 years) and the short term (18 months).

The overriding objective of Cambodia is to achieve a fair, just, and peaceful society, and, through accelerating the rate of economic growth, to raise the living standards of all Cambodian people. This objective is broken down into more specific goals:

- to double the present level of GDP by 2004 in real terms, and to place highlighted emphasis on agricultural, industrial, and tourism potential;
- to extend health, education, and social services in order to ensure a peaceful way of life and substantial improvement in the standard of living;
- to improve rural life by promoting rural development as a central feature of the development policies;
- to ensure that the pattern of development is sustainable socially, politically, fiscally, and environmentally;
- to strengthen domestic self-reliance and thereby reduce the current dependence on external financial and technical assistance.

Key objectives are to sustain economic growth at 7-8% per annum from 1994, and to reduce annual inflation to under 10% in 1994 and 5% afterwards.

The principal goals in the agricultural sector are:

- to ensure food security at both national and household levels;
- to produce surpluses for export not only of rice but also of other crops;
- to expand rubber production for increased foreign exchange;
- to encourage the production of raw materials for local agro-industries; and
- to improve the well-being and incomes of the rural population.

Rural development in Cambodia is strongly united with the agricultural sector, and some 17 priority areas that are seen as being critical to rural development are shown. Main priorities are:

- to provide adequate water supply for drinking, domestic use, and irrigation;
- to repair, rehabilitate, and construct rural roads;
- to establish small enterprises and income-generating activities;
- to develop alternative energy sources; and
- to protect the environment and natural resources, and encourage reforestation.

Objectives in the manufacturing sector are:

- to favor labor-intensive or labor-absorbing industries;
- to promote export industries, efficient import-replacing industries, mainly those producing consumer goods;
- to attract foreign investment to encourage the transfer of technology; and
- to widen access to international markets and to privatize state enterprises and strengthen the management and financial position of those that remain state-owned.

Important considerations of the government are the promotion of those industries that optimize the use of local labor and domestic raw materials, as well as those that generate domestic value added from imported inputs.

2.3.3 Development Potential of the Region

Considerations on development potential below focus on the area on the left bank of the Mekong River where it is supposed to be susceptible to the Mekong Bridge. Therefore, the provinces of Kandal, Prey Veng, Svay Rieng, Kompong Cham, Ratanakiri, Stung Treng, Mondulakiri, and Kratie are broadly considered as the influence area of the Mekong Bridge. An excellent source of technical information on development potential is *Cambodia Agricultural Development Options Review (Phase I)* by FAO/UNDP, 1994.

(1) Natural Resource Base

The influence area of the Mekong Bridge is well endowed with natural resources, including a diversity of agro-ecological zones suited to a wide range of crops and livestock, and rich biological resources.

This area can be divided into two major geomorphologic regions; (i) the central Mekong Basin/Delta, and (ii) the periphery of the basin and mountainous area on the northeastern side of the country.

The central Mekong Basin can be distinguished by: (i) the large inundated plains in the delta; (ii) the ancient alluvial terraces; (iii) the river banks and levees; and (iv) the swampy zones and lakes behind the levees. In the periphery of the basin, mainly northeastern highland can be observed.

Soils developed over basalt in the east and in particular the red soils are well suited for rubber, and river bank soils are of relatively high fertility. River bank soils can be cultivated year round but do not occupy large areas.

In the flat plain of the Mekong River rainfed lowland rice production is dominant with average yields of 1.3 tons/ha. Dry season flood recession rice production systems with

average yields of 2.7 tons/ha are mostly found in the provinces of Prey Veng and Kandal (Figure 2.4).

(2) Programs and Projects

At the subsector level, government efforts will concentrate on guiding private sector and farming activities in:

- intensifying rice and other crop production;
- expanding cultivated areas, essentially by reclaiming land abandoned during the war;
- developing small scale irrigation through rehabilitation of existing systems;
- increasing rubber production, notably by improving the management of state rubber plantations;
- expanding livestock production, particularly through disease control; and
- sustainable exploitation of forest and other natural resources.

Two methods of agricultural development are being pursued. One is the intensification of especially rice and other crops. The other is the expansion of cultivated areas with careful attention given to the deforestation and depletion of natural resources.

Rubber production is expected to be promoted because the procurement of foreign exchange and rehabilitation of state plantations which fall into the intensification are stressed.

In line with these objectives, agricultural sector development projects were proposed in the *National Programme to Rehabilitate and Develop Cambodia*, of which irrigation and flood control projects concentrate on the central plain region. Four projects out of nine totaling 35,000 ha are planned within the provinces of Kompong Cham, Prey Veng, and Kandal.

(3) Potential and Opportunities

The cultivated area that is concentrated in the alluvial basin around the hydrographic network of the Mekong River has the high potential for agricultural development. The periodic flooding of the Mekong River provides many benefits, including siltation of an extended area for agriculture (with permanent maintenance of soil fertility) and the development of fisheries in the inundated forests.

LEGEND



CLASS	CLASS DESCRIPTION
<p>I NATURAL AREAS</p> <p>A - FORESTS</p> <p>1 - Moist evergreen forest</p> <p>a - Broad-leaved forest</p> <ul style="list-style-type: none"> - Dense broad-leaved forest - Flooded evergreen forest - Mangrove forest - Mosaic of evergreen or deciduous forest and secondary vegetal formations - Mosaic of the flooded forest, swampy vegetation (allow land) - Secondary vegetal formations <p>b - Pine forest</p> <p>2 - Deciduous forest</p> <p>B - OTHER VEGETATION</p> <ul style="list-style-type: none"> - Thicket - Scrub, brushwoods - Grass savannah - Grassland susceptible to flooding - Swampy vegetation 	<p>II CULTIVATED AREAS</p> <ul style="list-style-type: none"> - Paddy fields - Paddy fields with palm trees - Mosaic of upland crops and secondary vegetal formations - Mosaic of fruit crops and tree garden / tree strip in the lowland - Plantation (Rubber) <p>III DISCUSSED AREAS</p> <ul style="list-style-type: none"> - Bare land and sandy bank
<p>IV OTHERS</p> <ul style="list-style-type: none"> - Open water - Quarry - Road - Railroad - Capital - Provincial city - International boundaries - Provincial boundaries 	

THE FEASIBILITY STUDY ON
CONSTRUCTION OF THE MEKONG BRIDGE
IN KINGDOM OF CAMBODIA

Figure 2.4
Land Use in the Region 1989
JAPAN INTERNATIONAL COOPERATION AGENCY



LEGEND

CLASS DESCRIPTION

1. AGRICULTURE

2. FOREST

3. WETLANDS

4. URBAN

5. WATER

6. BARREN

7. RIVERS

8. CANALS

9. ROADWAYS

10. AIRWAYS

11. UNCLASSIFIED AREAS

12. PROTECTED AREAS

13. NATIONAL BOUNDARIES

14. INTERNATIONAL BOUNDARIES

15. ISLANDS

16. LAKES

17. SWAMP

18. COASTAL

19. SAND

20. MOUNTAIN

CLASS



THE FEASIBILITY STUDY ON
CONSTRUCTION OF THE MEKONG BRIDGE
IN KINGDOM OF CAMBODIA

Figure 2.4
Land Use in the Region 1989
JAPAN INTERNATIONAL COOPERATION AGENCY

(a) Rice

There appears to be scope for expanding cultivation of rainfed lowland rice, but for flood recession rice the most attractive option is likely to be intensification. However, in the influence area, the room of expanding cultivation of rainfed lowland rice is scarce.

Instead, intensification of rainfed lowland rice through the use of selected varieties and more fertilizer would be possible in areas that already have supplementary irrigation during the rainy season or with satisfactory water control in provinces with high population densities and excess labor (Kandal, Svay Rieng, Prey Veng, and Kompong Cham).

The introduction of improved techniques is expected to raise average yields of rainfed lowland rice from 1.3 to 2 tons/ha. Also, similar intensification should be possible in most areas cultivated to dry season flood recession rice.

Regarding the subsidiary crops, Kompong Cham has the potential of diversified production of maize, soybean, mungbean, cassava, and sweet potato. Mungbean in Kandal, maize in Prey Veng and Kratie, cassava and sweet potato in Mondulhiri are now cultivated.

Prospects for the various subsidiary food crops are good, and there is a fairly large scope to improve yields from the current low levels (Table 2.4).

(b) Rubber

The red soil areas suitable to the rubber cultivation are distributed within the influence area; 187,000 ha in the lower Mekong Basin (mostly in Kompong Cham), 510,000 ha in the northeast plateau (180,000 ha in Ratanakiri, 320,000 ha in Mondulhiri, and 20,000 ha in Kratie). According to 1992 Landsat data, the rubber plantation area of these four provinces is estimated around 74,000 ha. On the contrary, according to a recent study, a realistic estimate of the potential area for rubber cultivation in this area is around 320,000 ha or more, with a potential of more than 6,000,000 tons of dry rubber. Cambodia appears to have a comparative advantage in producing this crop.

(c) Other Crops

Tobacco is cultivated on some 18,000 ha, mainly in the provinces of Kompong Cham, Kratie, Kandal, and Prey Veng in Cambodia. Except for Kratie, groundnut and sesame are grown in the same provinces as tobacco.

Table 2.4 Paddy Field Area in Cambodia

Region	Land Area (1,000ha)	Paddy Fields (Ar+Af) (1,000ha)			Paddy Yield (tons/ha)		
		1967	1991	Changes in percent	1967	1985	1991
Total	18104	2521	2639.2	5%	0.98	1.18	1.32
I Plain Region	2507	937	1098	17%	-	-	-
Phnom Penh	27	22	19	-14%	-	1.33	1.67
Kandal	359	84	54	-36%	1.11	1.80	1.92
Kompong Cham	980	211	220	4%	1.18	1.24	1.42
Svay Rieng	297	167	229	37%	1.14	0.96	1.02
Prey Veng	488	254	359	41%	0.80	1.00	1.19
Takeo	356	199	217	9%	0.81	1.29	1.49
II Tonle Sap Lake Region	5773	1140	1125	-1%	-	-	-
Kompong Thom	1381	175	193	10%	0.74	0.87	1.19
Siem Riep	1527	252	281	11%	0.88	1.01	1.2
Banteay Meanchey	994	-	197	-	-	-	1.31
Battambang	1043	466	250	-46%	0.96	1.22	1.41
Pursat	1269	170	149	-12%	0.98	1.17	1.16
Kompong Chhnang	552	77	55	-28%	1.12	1.30	1.32
III Coastal Region	1637	219	183	-17%	-	-	-
Sihanoukville	87	-	13	-	-	-	-
Kampot	521	160	153	-4%	1.33	1.39	1.32
Koh Kong	1116	60	17	-71%	1.00	1.33	1.33
IV Plateau and Mountain Region	6806	224	234	4%	-	-	-
Kompong Speu	702	137	87	-37%	1.07	1.20	1.21
Preah Vihear	1379	22	39	77%	-	1.67	1.33
Ratanakiri	1078	7	10	50%	1.00	1.36	1.29
Stung Treng	1109	5	19	318%	0.67	1.44	1.33
Mondulkiri	1429	0	6	-	1.00	1.43	1.25
Kratie	1109	53	73	37%	1.05	1.18	1.57

Source: Analysis of Land Cover Atlas by Landsat in Cambodia, Kawai, Department of Agricultural Hydraulics and Hydro-Meteorology based on the data in COVER ATAS by LANDSAT Cambodia, 1995; and Cambodia Agenda for Rehabilitation and Reconstruction, Country Department I, East Asia and Pacific Region, World Bank, 1992

Note: *Ar; Paddy fields

*Af; Receding and floating rice field

* Land area data by province are provided by Landsat. The area of Lake Tonle was not included in estimate of province areas.

* The summed up total and land areas does not agree with 18104 thousand ha, officially announced land area of Cambodia

Groundnut, which was cultivated on 23,000 ha in the late 1960s, has decreased in area (7,000 ha now) probably because of substitution by soybean in Kompong Cham and tobacco and mungbean on river levees. There is, however, good potential for increasing returns from groundnut with improved practices.

Production of cotton, which was grown before the war on the well-suited soils in Kompong Cham and Kandal has stopped since the 1970s mainly due to the lack of processing facilities, competition with massive imports from the former Soviet Union in the 1980s and the presence of land mines. The development of cotton would require substantial investments in rehabilitating and/or modernizing the existing state factories.

Sugarcane is found along the Mekong River banks in Kandal and Kompong Cham. It is profitable when produced on a small scale in homeyards. However, it may be much less attractive on an industrial scale and sugarcane may not be able to compete with soybean which is grown in similar areas.

Coffee can be grown in Kompong Cham, Ratanakiri, and hilly areas of Monduliri. Although Cambodia was self-sufficient in coffee and even exported this product in the late 1960s, current production is nil. Nevertheless, Cambodia is not in a position to compete with other coffee-producing countries.

Cashew finds a good agroecological conditions in Svay Rieng and Kompong Cham. A cashew development programme is underway in Monduliri. Cashew nut is found to have good economic prospects for export.

(4) Possibility of Expanding Cultivated Areas

(a) Rice

Rainfed lowland rice areas which could be reclaimed are located in the provinces around Tonle Sap, and there is almost no room for reclamation within the influence area. Most of the area suitable for flood recession rice is already being cultivated. For instance, unutilized grassland area in the influence area of the central plain has steeply decreased to almost nil over the last two decades.

(b) Rubber

There is no land resource limitation for rubber development in Cambodia at present. There are some 300,000 ha of available land with red soils in which rubber is already grown. This potential would enable a very large development program (Table 2.5).

Table 2.5 Rubber Plantation Area in Cambodia

Region	Land Area (1,000ha)	Rubber Plantation Area (1,000ha)			Share in percent
		1985	1992	Changes in percent	
Total	18104	83	75	-10%	0%
I Plain Region	2455	73	72	-2%	3%
Phnom Penh	40	0	0	-	0%
Kandal	366	0	0	-	0%
Kompong Cham	936	73	72	-2%	8%
Svay Rieng	285	0	0	-	0%
Prey Veng	485	0	0	-	0%
Takeo	343	0	0	-	0%
II Tonle Sap Lake Region	5804	1	1	-14%	0%
Kompong Thom	1308	1	1	-14%	0%
Siem Riep	1573	0	0	-	0%
Banteay Meanchey	748	0	0	-	0%
Battambang	1250	0	0	-	0%
Pursat	1146	0	0	-	0%
Kompong Chhnang	528	0	0	-	0%
III Coastal Region	1798	0	0	-	0%
Sihanoukville	143	0	0	-	0%
Kampot	502	0	0	-	0%
Koh Kong	1296	0	0	-	0%
IV Plateau and Mountain Region	6984	9	2	-77%	0%
Kompong Speu	676	0	0	-	0%
Preah Vihear	1359	0	0	-	0%
Ratanakiri	1256	4	0	-	0%
Stung Treng	1118	0	0	-	0%
Mondulhiri	1370	0	0	-	0%
Kratie	1206	5	2	-58%	0%

Source: Analysis of Land Cover Atlas by Landsat in Cambodia, Kawai, Department of Agricultural Hydraulics and Hydro-Meteorology based on the data in COVER ATAS by LANDSAT Cambodia, 1995

Note: * Land area data by province are provided by Landsat. The area of Lake Tonle was not included in the estimate of province areas.

* The summed up total of land areas does not agree with 18104 thousand ha, officially announced land area of Cambodia.

(c) Other Crops

In Ratanakiri and Mondulhiri provinces there are areas with soils that are highly suitable for the expansion of diversified crops (e.g., more than 300,000 ha of latosols are found in these provinces). The levees of the Mekong river could be cultivated by rehabilitation of river banks and "colmatage" canals.

Expansion into areas covered with forest and with soils of medium to low potential for diversification, such as hydromorphic soil found in Kompong Cham and Kratie provinces at the foot of basalt, may be considered.

(d) Perennial Crops

Large deforested and degraded areas are potentially suitable for cashew cultivation in Mondulhiri province (Table 2.6).

Table 2.6 Unutilised Grass Land Area in Cambodia

Region	Land Area (1,000ha)	Rubber Plantation Area (1,000ha)			Share in percent 1992
		1985	1992	Changes in percent	
Total	18104	720	245	-66%	1%
I Plain Region	2455	396	39	-90%	2%
Phnom Penh	40	2	2	-21%	5%
Kandal	366	53	8	-85%	2%
Kompong Cham	936	51	1	-99%	0%
Svay Rieng	285	79	0	-100%	0%
Prey Veng	485	125	5	-96%	1%
Takeo	343	86	23	-73%	7%
II Tonle Sap Lake Region	5804	236	144	-39%	2%
Kompong Thom	1308	156	69	-56%	5%
Siem Riep	1573	13	17	27%	1%
Banteay Meanchey	748	8	15	90%	2%
Battambang	1250	20	36	76%	3%
Pursat	1146	9	6	-36%	0%
Kompong Chhnang	528	30	2	-93%	0%
III Coastal Region	1798	42	11	-75%	1%
Sihanoukville	143	8	1	-83%	1%
Kampot	502	33	9	-72%	2%
Koh Kong	1296	2	0	-94%	0%
IV Plateau and Mountain Region	6984	46	52	13%	1%
Kompong Speu	676	4	1	-74%	0%
Preah Vihear	1359	1	0	-100%	0%
Ratanakiri	1256	0	1	500%	0%
Stung Treng	1118	1	0	-100%	0%
Mondulhiri	1370	37	39	-	3%
Kratie	1206	3	11	289%	1%

Source: Analysis of Land Cover Atlas by Landsat in Cambodia, Kawai, Department of Agricultural Hydraulics and Hydro-Meteorology based on the data in COVER ATAS by LANDSAT Cambodia, 1995

Note: * Land area data by province are provided by Landsat. The area of Lake Tonle was not included in the estimate of province areas.

* The summed up total of land areas does not agree with 18104 thousand ha, officially announced land area of Cambodia.

(5) Possibility of Increasing Yields

(a) Rice

Where there is reasonable water control, intensification of rice cultivation is possible through the use of fertilizer, improved varieties, quality seeds and, for dry season production, improved pest management.

Intensification of rainfed lowland rice through the use of selected varieties and more fertilizer would be possible in areas which already have supplementary irrigation during the rainy season or with satisfactory water control in provinces with high population densities and excess labor (Kandal, Svay Rieng, Prey Veng, and Kompong Cham).

The introduction of improved techniques is expected to raise average yields of rainfed lowland rice from 1.3 to 2 tons/ha. Also, similar intensification should be possible in most areas cultivated to dry season flood recession rice.

(b) Rubber

Rehabilitation of the large plantations in Kompong Cham, Ratanakiri, and Monduliri provinces with red soils is potentially very profitable, as the initial investment cost has already been recouped.

(c) Other Crops

The current level of productivity being very low, there is significant potential for increasing existing production of crops through intensification, especially for crops such as legumina, cotton, maize, and vegetables.

(6) Constraints

Constraints to agricultural development include both natural/environmental limitations and those caused by years of war. Constraints to agricultural development, especially those pertaining to infrastructure, in the influence area are reviewed.

The existing poor transport system is a major constraint to agricultural development, causing the following social problems:

- The smooth movement of agricultural products from producers to consumers remains difficult and costly.
- Agricultural products from the areas adjacent to the country's border find markets in neighboring countries through smuggling, instead of supplying deficit areas within the country.

- In view of the possibilities for increased export production, insufficiency of the internal transportation systems as well as international ports constrain agricultural development.

The negative consequences of an inadequate and weak transportation system on prices of agricultural commodities are twofold: (i) consumer prices in urban as well as deficit areas are raised; and (ii) producer prices are depressed, encouraging farmers to abandon agricultural land and migrate to the city as laborers.

Since communications between the central government and its provincial offices are poor, this limitation hinders implementation of government agricultural programs. The insufficient transport system also confines access to labor, which is the principal constraint to farming in zones with seasonal labor shortages.

2.4 Functions of a Mekong River Bridge

In addition to providing the missing link for road traffic, a Mekong Bridge (the first one in Cambodia) will play a much broader role than a simple local bridge. Its importance is assessed in the following discussion.

2.4.1 Transport Functions

The main transport functions of a Mekong Bridge in Cambodia are:

(1) Improvement of Accessibility between Phnom Penh and Remote Areas in the Left Bank

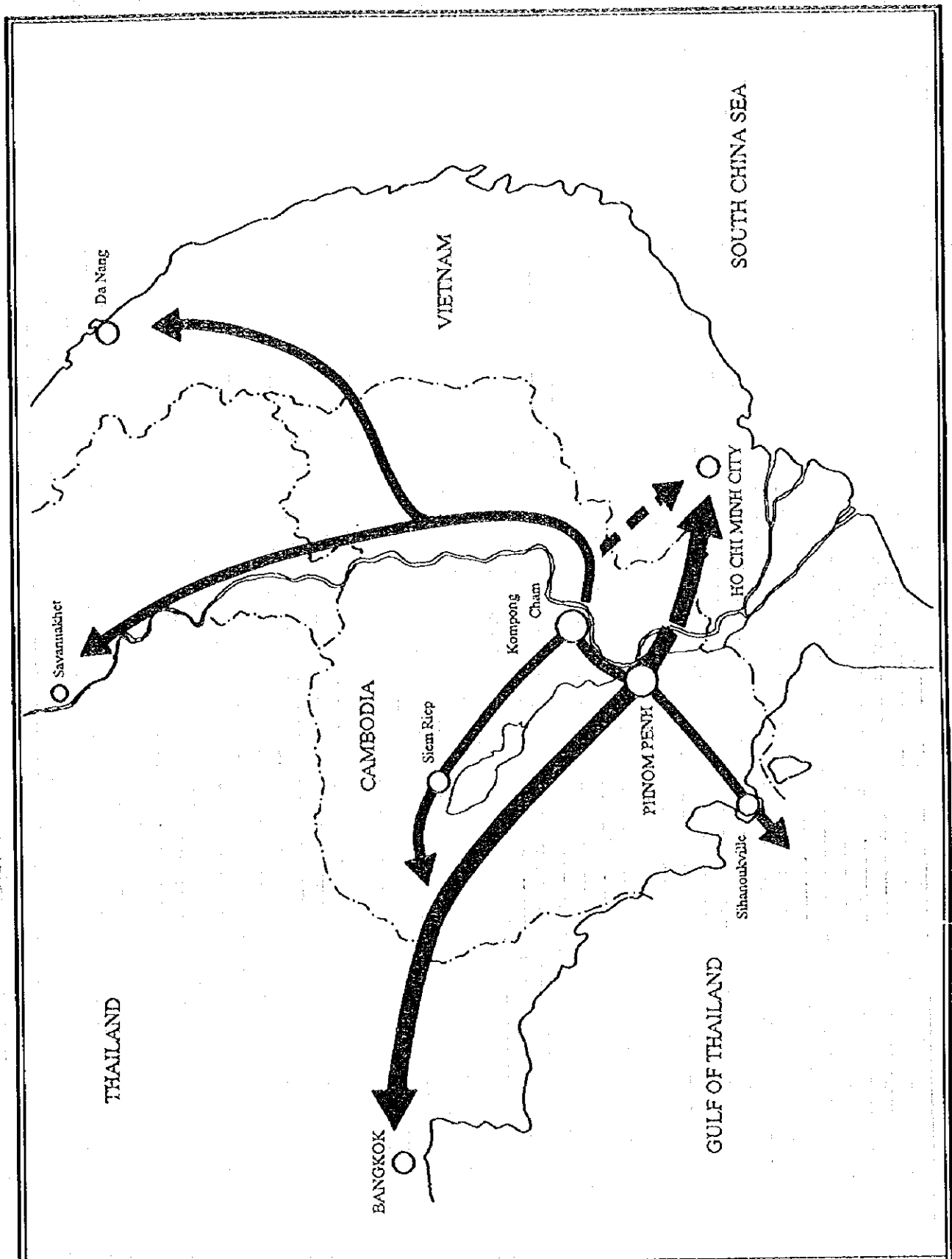
Cambodia is dissected north-south by the Mekong River, and access to eastern Cambodia from Phnom Penh is severely restricted. Some remote areas, mainly northeastern Cambodia are effectively isolated because of deteriorated roads to such an extent that vehicles can hardly pass. A Mekong Bridge is expected to provide a good road connection between Phnom Penh and remote areas on the left bank of the river.

(2) Improvement of the International Road Network

As stated in the *National Programme to Rehabilitate and Develop Cambodia*, strengthening linkages with neighboring countries is a strategy to expand foreign trade, including imports, exports, and tourist traffic, which should be actively pursued. Traffic between Cambodia and Viet Nam depends on rivers (Mekong and Bassac) and roads (Routes 1, 2, 21, 72, and 78). The volume of transit traffic through Cambodia is insignificant at present. Routes 72 and 78 originate from Route 7. Road 78 serves as a lifeline for the provinces of Stung Treng and Ratanakiri, and it also offers the shortest route to central Viet Nam. Route 72 provides the most direct link from Siem Riep and Kompong Cham to Ho Chi Minh City, via Tay Ninh. Route 1 constitutes the axis of Bangkok-Phnom Penh-Ho Chi Minh City and is expected to reinforce its role as the main route for trade with Viet Nam. A Mekong Bridge is expected to improve the international connection between Cambodia and neighboring countries (Figure 2.5).

2.4.2 Effects on Regional Development

The Construction of a Mekong Bridge is expected not only to bring a drastic change in the arterial road network in Cambodia, but also to influence regional development through reductions in travel time and cost. The following are envisaged as principal effects:



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Figure 2.5
Formation of International Network
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(1) Promotion of a Market-Oriented Economy

Government strategy for achieving sustainable growth is to commit itself with implementing the mechanism of a market economy, which requires the expansion of markets. An improved transport network can bring about the expansion of diverse markets such as commercial goods, input, labor, knowledge, etc., as witnessed by what has taken place after the opening of the Chroy Chang Va Bridge and Route 6A. A Mekong Bridge is expected to promote a market-oriented economy through the expansion of markets, both domestic and international (Figure 2.6).

(2) Upgrading of Living Standards in Rural Areas

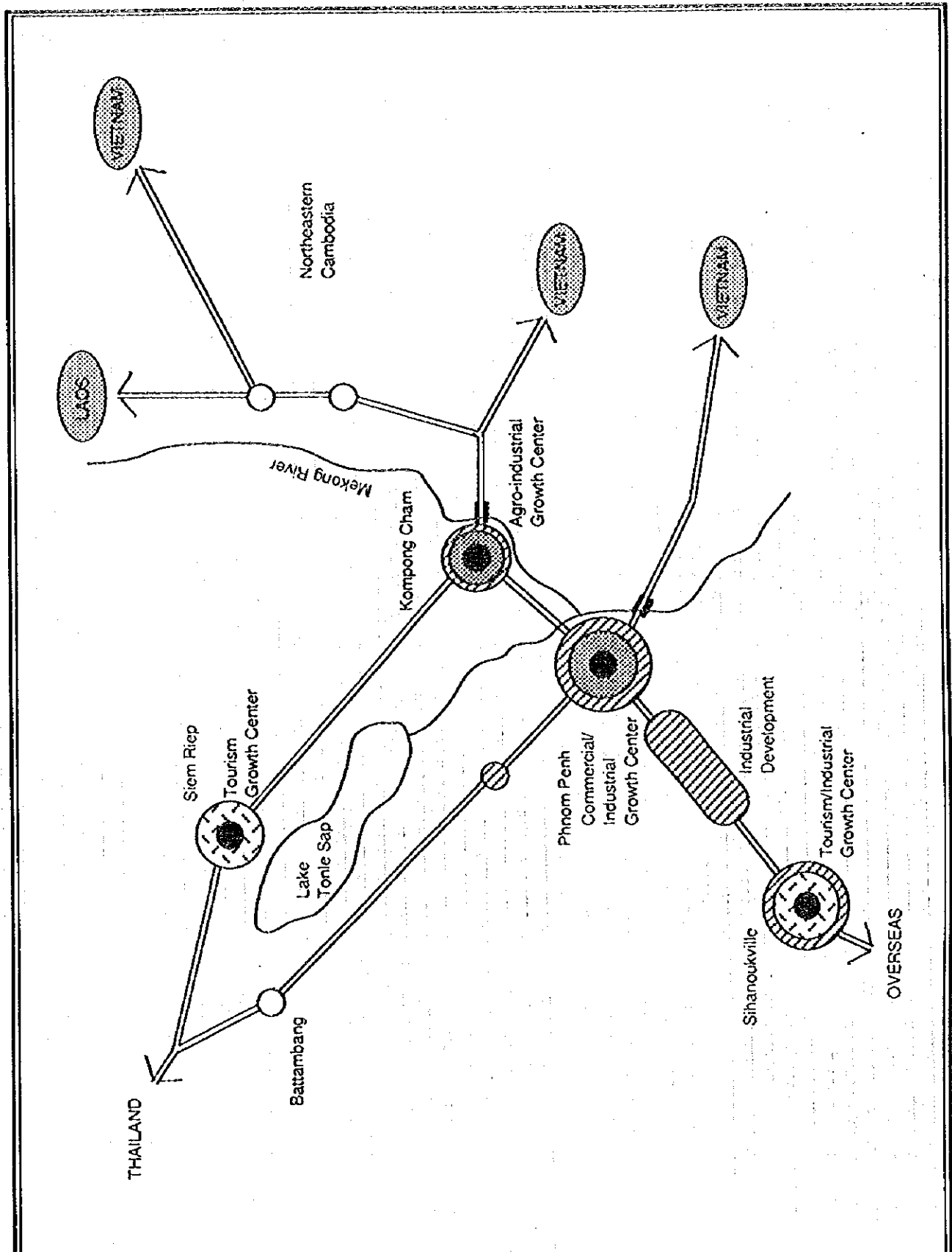
The standard of living, not only measured by income level, but also in terms of accessibility to health, education, and social services, depends on transport conditions. Rural areas in Cambodia are much disadvantaged in this regard due to the poor transport conditions. A Mekong Bridge can provide rural areas with good access to Phnom Penh and/or Kompong Cham, where various social services are concentrated; a Mekong Bridge or can also induce the formation of such services.

(3) Promotion of Agricultural Development

The agricultural sector is likely to remain the mainstay of Cambodia's economy, though its relative significance will decrease. Roads, together with irrigation systems, form the fundamental infrastructure for intensification of agricultural production and expansion of cultivated areas enabling easier input of labor, fertilizer, and machines than before. In eastern areas of the Mekong River, there is a good possibility for the intensification of rice and cash crops in Kandal, Svay Rieng, Prey Veng, and Kompong Cham and in expansion and rehabilitation of rubber plantations in Kompong Cham, Monduliri, and Ratanakiri. Monduliri and Ratanakiri are expected to produce commercial tree crops making use of soil and climatic conditions. A Mekong Bridge is expected to provide the base for agricultural development.

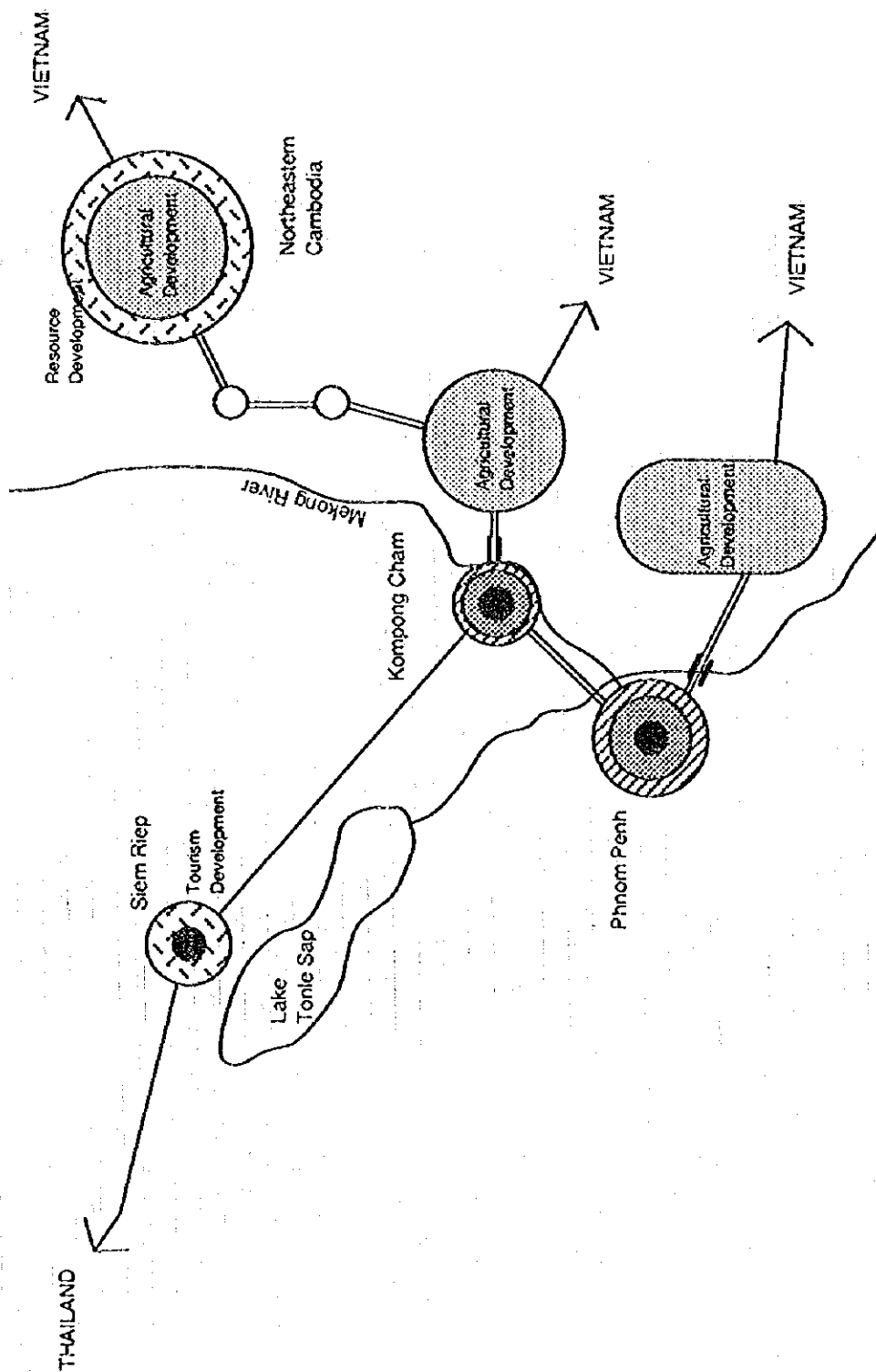
(4) Promotion of Resource Development

There are no mining activities in Cambodia at present. However various mineral sources of unknown quantities have been reported. In the provinces of Monduliri and Ratanakiri deposits of base metals, bauxite, and gold are reported, and in Stung Treng base metals, iron, some industrial and construction materials, and coal/lignite deposits are reported. In northeastern mountainous areas, the possibility of hydro-power generation is also reported. This resource development basically depends on transport conditions. In addition, better use of tourism resources, such as ancient cultural assets or national parks, is conditional on road network improvements. A Mekong Bridge is expected to provide the base for resource development (Figure 2.7).



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Figure 2.6
Market-Oriented Economy Development
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Figure 2.7
Agricultural/Resource Development
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(5) Balanced Development of the Area

The insufficient road network prevents the eastern bank of the Mekong River from balanced development relative to the west bank. This imbalance appears in population sparsity and undeveloped land use (e.g., Mondulkiri, Ratanakiri) or in the lack of development plans (e.g., Kandal, Prey Veng) despite their potential.

A Mekong Bridge is expected to be the fundamental transport infrastructure input for balanced development of the country.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for transparency and accountability, particularly in financial matters. This section outlines the various methods and tools used to collect and store data, ensuring that information is readily accessible and secure.

2. The second part of the document focuses on the analysis and interpretation of the collected data. It describes the process of identifying trends, patterns, and anomalies, which can provide valuable insights into the underlying causes of certain events or behaviors. This analysis is crucial for making informed decisions and developing effective strategies to address any issues that may arise.

3. The third part of the document addresses the communication and reporting of the findings. It highlights the importance of presenting the data in a clear, concise, and understandable manner, using appropriate visual aids and formats. This section also discusses the role of stakeholders in the reporting process and the need for regular updates and communication to keep everyone informed of the latest developments.

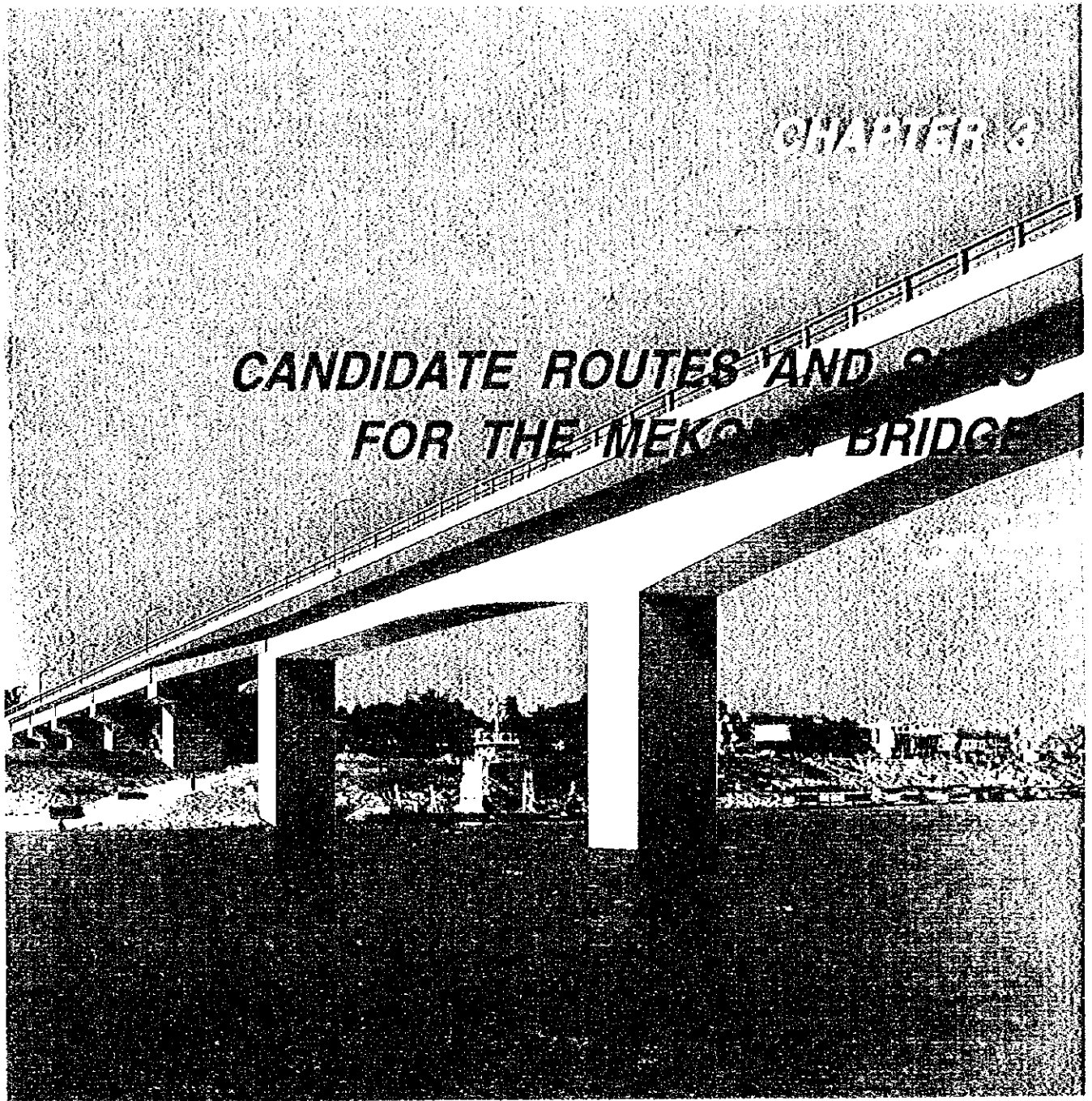
4. The final part of the document provides a summary of the key points and conclusions. It reiterates the importance of maintaining accurate records and the value of data analysis in decision-making. It also offers some recommendations for future actions and improvements, based on the findings of the study. This section serves as a call to action, encouraging all parties involved to continue to work together to enhance the quality and effectiveness of the data collection and analysis process.

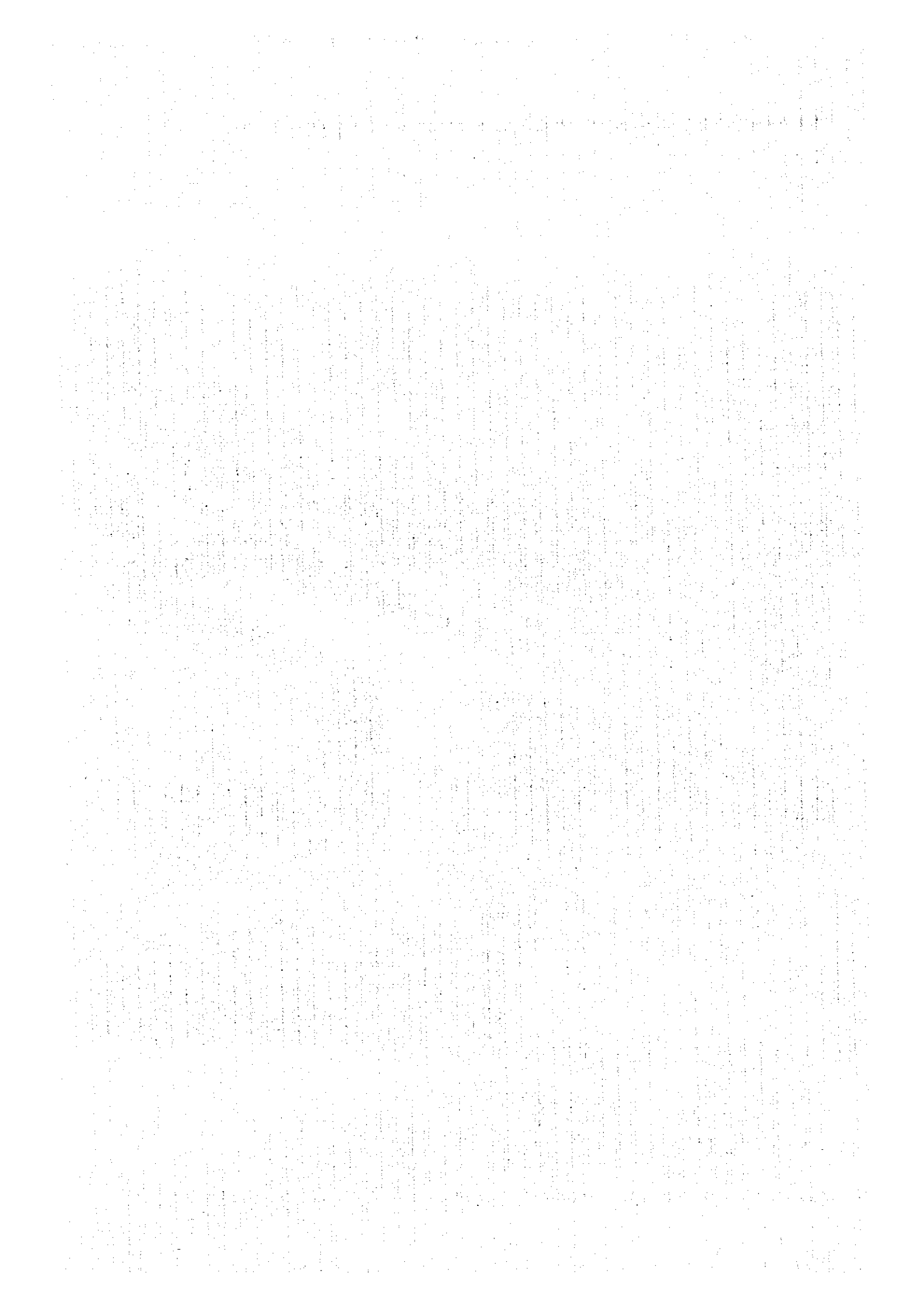
5. The first part of this section discusses the challenges and limitations of the current data collection and analysis process. It identifies several key areas where improvements are needed, such as enhancing the accuracy and reliability of the data, streamlining the collection process, and improving the efficiency of the analysis. It also discusses the importance of addressing these challenges to ensure that the data remains relevant and useful for decision-making.

6. The second part of this section describes the proposed solutions and improvements. It outlines a comprehensive plan for addressing the identified challenges, including the implementation of new data collection methods, the use of advanced analysis tools, and the establishment of a robust data governance framework. This plan also includes a timeline for implementation and a clear assignment of responsibilities to ensure that the improvements are effectively executed.

7. The third part of this section discusses the expected benefits and outcomes of the proposed improvements. It highlights how the enhanced data collection and analysis process will lead to more accurate and timely information, which will enable better decision-making and more effective resource allocation. It also discusses the potential for increased transparency and accountability, as well as the overall improvement in the organization's performance and efficiency.

8. The final part of this section provides a conclusion and a call to action. It summarizes the key findings and recommendations, and emphasizes the need for all parties involved to work together to implement the proposed improvements. It also offers some final thoughts on the importance of data in the modern business environment and the role of each individual in ensuring the success of the organization.





CHAPTER 3 CANDIDATE ROUTES AND SITES FOR THE MEKONG RIVER BRIDGE

This chapter presents an overview of the road network in the study area, discusses alternative routes and locations for the Mekong River Bridge, and provides information on access roads to alternative bridge sites.

3.1 Road Network In the Study Area

The study area for the Feasibility Study on construction of the Mekong Bridge consists of the alternative potential bridge locations at Neak Loeung, Prek Tamak, and Kompong Cham and of the area between them. The study area is served by several primary roads. These are Routes 1, 6A, 6, 7, and 11 which are national paved roads. Several provincial and local, unpaved roads are also situated within the study area (see Figure 3.1).

Route 1 starts in Phnom Penh and, after crossing the Bassac River via the Monivong Bridge, follows the west bank of the Mekong River in a southeastward direction to Neak Loeung. The distance from the Monivong Bridge to Neak Loeung is 56 km. At Neak Loeung road traffic crosses the Mekong by way of a ferry service, and Route 1 then continues in an eastward direction to the border with Viet Nam, a distance of 104 km.

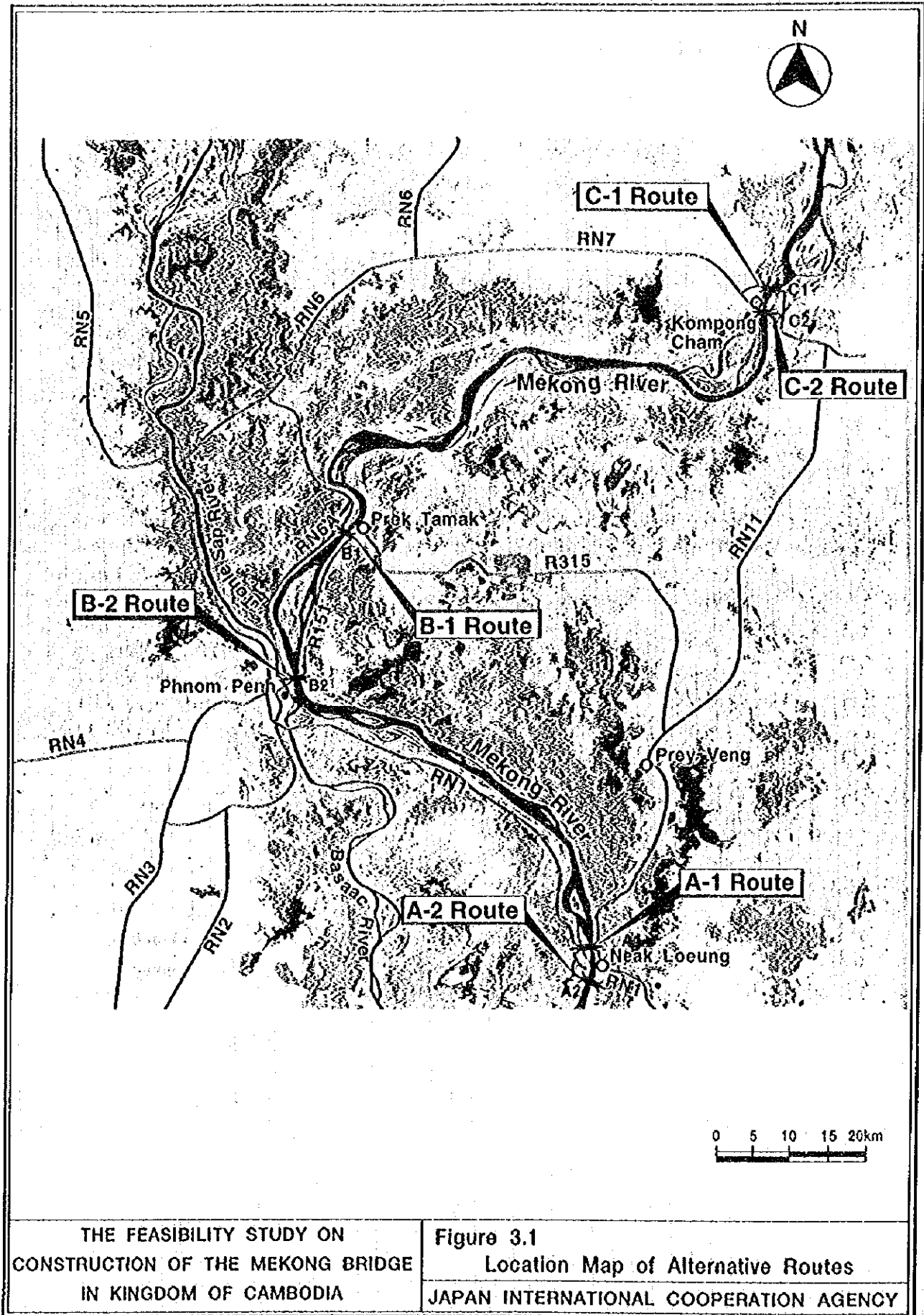
Route 6A begins in Phnom Penh, crosses the Sap River via the Chroy Chang Va Bridge, and continues in a northward direction along the west bank of the Mekong River, passing Prek Tamak. About 35 km from Phnom Penh the road turns west, ending at its junction with Route 6. Route 6A has a length of about 44.5 km from the Chroy Chang Va Bridge to the junction with Route 6.

The section of Route 6 within the study area starts at its junction with Route 6A and proceeds in an eastward direction to the junction with Route 7 at the town of Skun, a distance of about 29.5 km.

Route 7 originates at its junction with Route 6 and continues in an eastward direction to Kompong Cham, a distance of 45 km. Road traffic crosses the Mekong River by ferry, and Route 7 then continues from the ferry landing in an eastward direction to the junction with Route 11, a distance of 12.7 km. Thereafter Route 7 proceeds towards Laos, with a branch to Viet Nam from the Cambodian town of Krek.

Route 11 begins in Neak Loeung at the east bank of the Mekong River and continues northward until its junction with Route 7, a distance of 91 km. Route 11 passes through the towns of Prey Veng and Svay Antor.

Of the many provincial and local roads in the study area, two are of importance for this study. One starts at the Svay Chrum ferry landing on the east bank of the Mekong River (across the river from Phnom Penh), follows the river in a northward direction, and ends at Prek Tamak, a distance of 20.5 km. It is a local road currently without an official designation. In this report it is referred to by its former designation as Route 151.



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Figure 3.1
Location Map of Alternative Routes
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The other local/provincial road begins at Prek Tamak at the east bank of the river and continues in a generally eastward direction, ending at its junction with Route 11 north of Svay Antor, a distance of 60 km. For the first 30 km this road has no official designation as it is considered a local road. The middle 22 km section is part of the newly designated Provincial Road 315. The remaining 8 km section consists of a trail. In this report the entire road is referred to as Route 315.

3.2 Candidate Locations for the Main Bridge

The candidate locations for the Mekong bridge are the two main east-west routes crossing the Mekong River, i.e., Route 1 at Neak Loeung and Route 7 at Kompong Cham, and a third location at Prek Tamak that would connect Route 6A with Route 315, providing a new east-west route between Phnom Penh and Prey Veng. At all candidate locations, ferries are currently served, the largest ones being those at Neak Loeung and Kompong Cham. These alternative bridge routes are discussed further below. The photographic records are arranged in Appendix 3.1.

3.2.1 Neak Loeung

A bridge at Neak Loeung would connect the sections of Route 1 located west and east of the Mekong River. The comparative advantages of a bridge at this location are that: (1) this river crossing constitutes the most highly patronized vehicular ferry service in Cambodia; (2) the bridge would be located on the important Asian Highway linking Bangkok, Phnom Penh, and Ho Chi Minh City; and (3) the bridge would be easy to access, because the surrounding area is not yet developed. A major disadvantage is that, based on international agreements, a bridge at this location must be designed to provide a clearance of 37.5 m from the high water level. This relatively high clearance would constrain the bridge to be far longer and therefore more expensive than bridges at either of the other two locations, where a clearance of only 15 m is required.

3.2.2 Prek Tamak

A bridge in this general location would connect Route 6A with Route 315. Advantages of a bridge at this location are that: (1) this river crossing is the closest to Phnom Penh, the capital city; (2) the bridge would require a clearance of only 15 m; (3) the bridge would provide additional access between Phnom Penh and Prey Veng Province via Routes 6A, 315, and 11, thereby encouraging economic development of the province; and (4) the bridge could potentially support a third route to Viet Nam through an eastward continuation of Route 315. Disadvantages of this route include the very low current volume of vehicular traffic crossing the river at this location, and the high cost of reconstructing and upgrading Route 315. Essentially, a bridge constructed at this location would not be well utilized without the complete renewal of Route 315.

3.2.3 Kompong Cham

A bridge at Kompong Cham would link the sections of Route 7 located west and east of the Mekong River. Comparative advantages of this bridge are that: (1) this river crossing is currently the secondmost heavily traveled vehicular ferry crossing on the Mekong; (2) the bridge would provide a fixed crossing on an alternative Thailand-Cambodia-Viet Nam Asian Highway linking Bangkok with the northern provinces of Cambodia and Ho Chi Minh City; (3) the bridge would greatly improve access between Laos and Phnom Penh and the Sihanoukville Port via Routes 7, 6, 6A, and 4; (4) the bridge would promote economic development in Kompong Cham Province and in the northeastern provinces of Cambodia, which are rich in natural resources; and (5) the bridge would require a clearance of only 15 m. Disadvantages include its longer distance from Phnom Penh and the potential difficulty, high cost, and environmental impact of constructing the western approach, which would lie within the city of Kompong Cham.

3.3 Alternative Routes for the Main Bridge

Two alternative routes were considered for each candidate location, as discussed below.

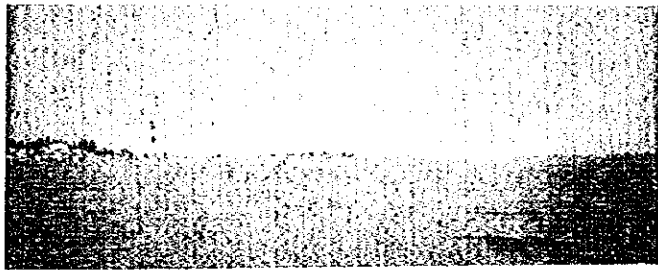
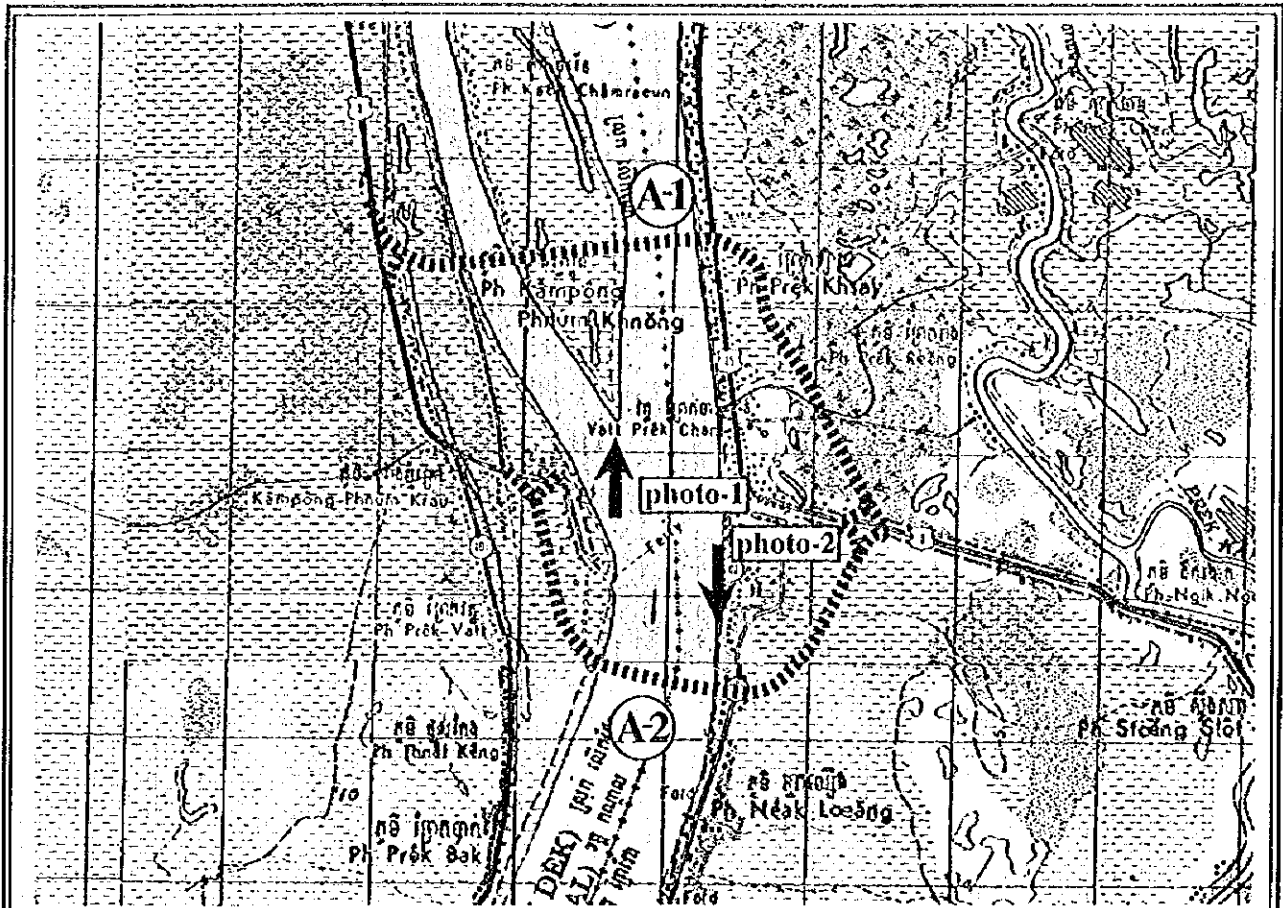
3.3.1 Neak Loeung

The two alternative routes considered for this bridge are: A-1, north of the existing ferry line, over Phnum Khnong island; and A-2, south of the ferry, near the town of Neak Loeung (see Figure 3.2). The A-2 crossing is the shortest in the vicinity of Neak Loeung, with a river width of about 880 m. A-1 is considerably longer, about 1,800 m from river bank to river bank, consisting of two channels separated by Phnum Khnong Island. The eastern, main channel is about 575 m wide, and the western, shallow channel is about 255 m wide, for a total river width of 830 m.

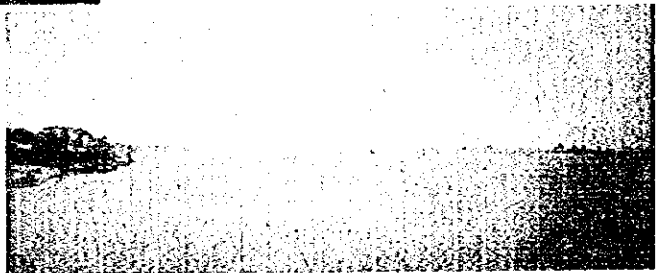
3.3.2 Prek Tamak

Two alternative routes were considered for this crossing: B-1 and B-2. The B-1 route is located north of the existing Prek Tamak ferry line and south of the town of Prek Tamak (see Figure 3.3). The B-2 route is actually located some 20 km south of Prek Tamak, just north of the Svay Chrum ferry service near Phnom Penh (see Figure 3.3). The river widths at B-1 and B-2 are about 900 m and 1030 m, respectively.

With a bridge at B-1, the distance from Phnom Penh to Route 11 at Svay Antor (via Route 6A, the B-1 bridge, and Route 315) would be about 85 km. This routing would require reconstructing and upgrading 59.5 km of Route 315.



A - 1 route (photo - 1)



A - 2 route (photo - 2)

Selection of Route : Two alternative routes are selected, A-1 and A-2 avoiding town of Neak Loang. As A-1 route is planned to pass through island, construction area in the river will be reduced but length of bridge becomes longer. A-2 route is to over 1,900m due to securing 35m navigational clearance.

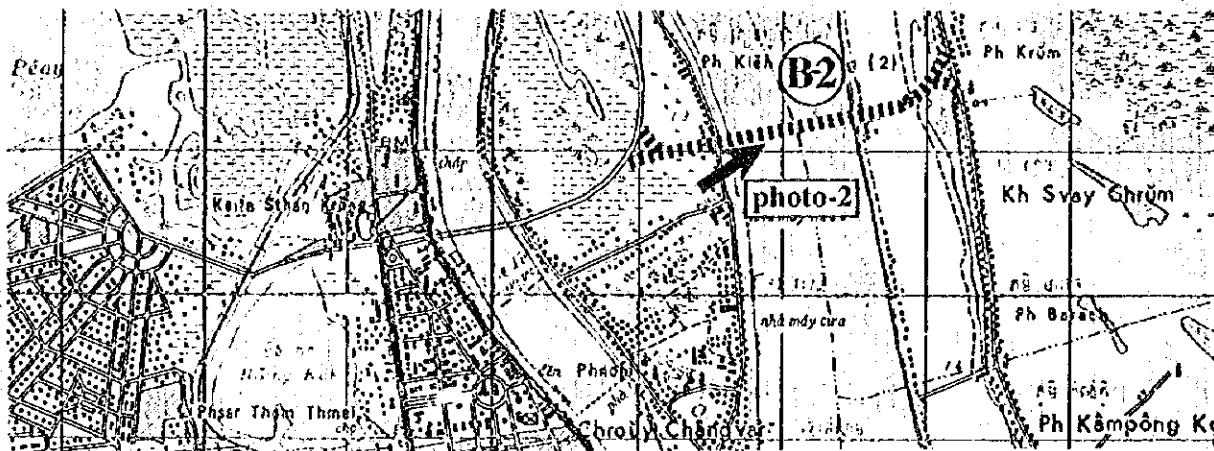
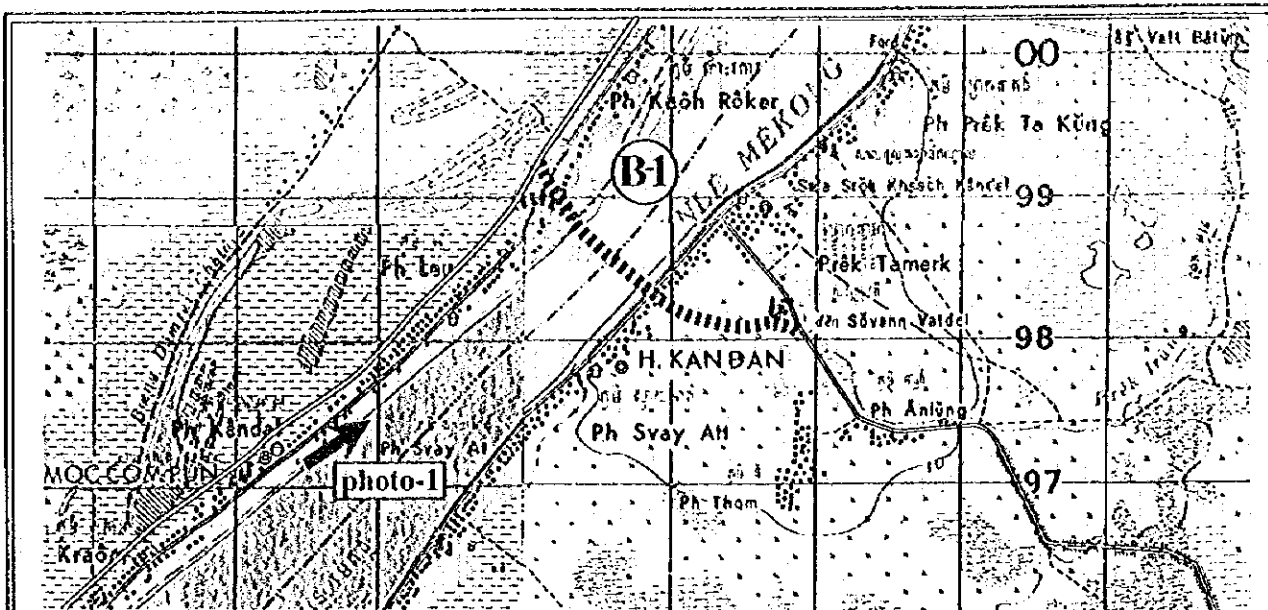
Width of River : 1,800m for A-1 1,080m for A-2

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Figure 3.2

Location Map of A1 and A2 Routes

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B-1 route (photo-1)



B-2 route (photo-2)

Selection of Route : Around Prek Tamak B-1 and B-2 routes selected. A bridge on B-1 connects Route 6A with Route 315, while a bridge on B-2 located near Phnom Penh connects the beginning of Route 6A with Route 151. Both bridges have a 15m navigational clearance; the bridge length of B-1 is about 1,030m and that of B-2 extends for about 1,370m.

Width of River : 900m for B-1 1,000m for B-2

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Figure 3.3
Location Map of B1 and B2 Routes
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The B-2 crossing would connect the beginning of Route 6A with Route 151 at Svay Chrum. By constructing a road linking Route 151 and Route 315, the distance between Phnom Penh and Route 11 to Svay Antor via B-2 would be about 70 km. The following roadwork, totaling 65.5 km, would be required: reconstructing and upgrading about 7.5 km of Route 151 from Svay Chrum to Taval; constructing a new 10 km road linking Route 151 with 315 from Taval to Thmei, about 11 km south of Prek Tamak; and reconstructing and upgrading 48 km of Route 315.

The area between Taval and Thmei is subjected annually to heavy flooding, and it is inundated year-round by several large swamps; consequently, a road passing through this area would require extensive bridge and viaduct crossings. This situation would render construction of the 10 km Taval-Thmei road section very difficult and cost prohibitive.

3.3.3 Kompong Cham

The two alternative routes considered for this bridge are C-1 and C-2. Both are located north of the existing ferry lines. The Mekong is about 820 m wide at C-1 and 1,200 m wide at C-2 (see Figure 3.4).

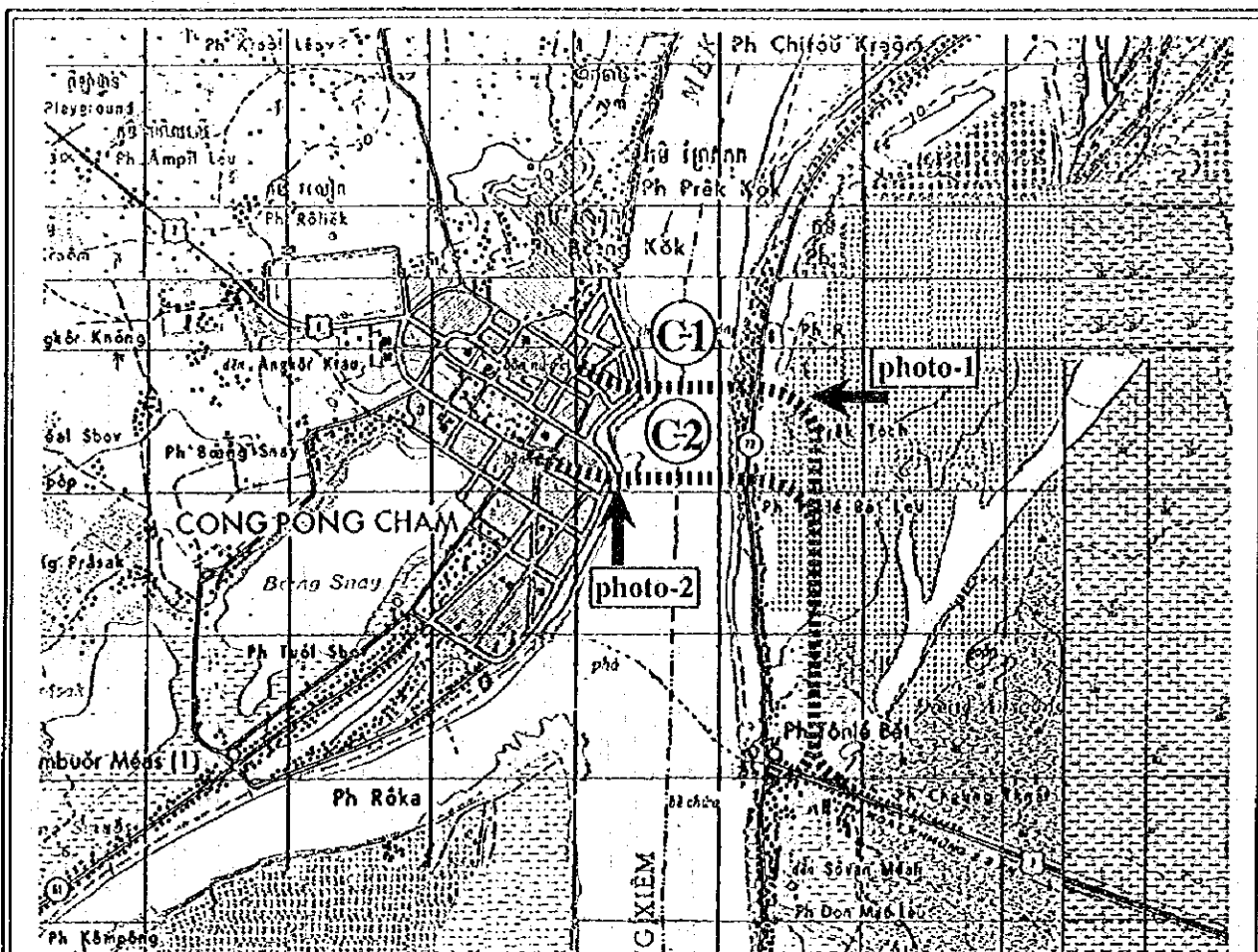
Both bridge sites would have western approaches starting within the city of Kompong Cham. The western approach road of C-2 is situated close to the town's commercial center, and constructing it might affect more buildings than the C-1 approach road. On the other hand, the eastern approach road of C-1 would be about 700 m longer than that of C-2.

3.4 Road Inventory Survey

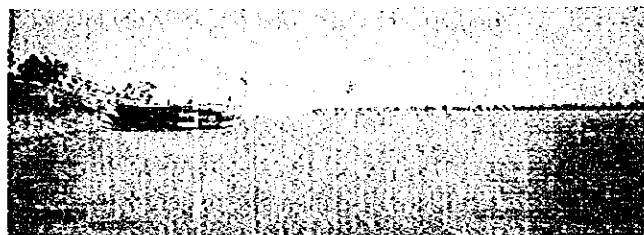
All project area roads were visited several times by the Study Team in April, May, and June 1995. Surveys to assess the physical condition of roads and bridges in the project area were conducted in mid-May and early June 1995. Project area roads and bridges are described respectively in section 3.5.

Road inventories were prepared for the pertinent sections of Routes 1, 6A, 6, 7, 11, 315, and 151, totaling about 505 km. Road characteristics noted by the Study Team include type of terrain; road width, type, and condition; shoulder width, type, and condition; embankment height, condition, and sufficiency; and the main features of the land within the immediate vicinity of the road. Additional complementary information used to assess road characteristics for Routes 1, 6, 7, and 11 was obtained from the Cambodia Transport Rehabilitation Study, sponsored by the Asian Development Bank.

The current general conditions, ongoing works, and plans for the project area roads are summarized below.



C - 1 route (photo - 1)



C - 2 route (photo - 2)

Selection of Route : Two alternative routes, C-1 and C-2, link the section of Route 7 at the west and east of the Mekong River, passing through near the town of Kompong Cham. The river The navigational clearance of both bridges requires 15m height. Bridge length is about 1,060m and 1,330m respectively on C-1 and C-2 route.

Width of River : 820m for C-1 1,080m for C-2

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Figure 3.4
Location Map of C1 and C2 Routes
JAPAN INTERNATIONAL COOPERATION AGENCY

3.4.1 Route 1

Route 1, a 160 km road from the Monivong Bridge over the Bassac River in Phnom Penh to Bavet at the Vietnamese border, consists of a penetration macadam roadway, 4.5 to 6 m wide, with 0 to 1 m shoulders. The embankment height is generally 3 to 5 m for the first 110 km and less than 1 m for the last 50 km.

The first 56 km section from the Monivong Bridge in Phnom Penh to Neak Loeung is currently being rehabilitated and widened to a 6 m roadway (carriageway) surfaced with DBST, with two 1.5 m shoulders. This project is funded by the Asian Development Bank. The 104 km section from Neak Loeung to the Vietnamese border is also scheduled for rehabilitation to the same standards. Plans are currently being discussed to reconstruct the entire road, raising the embankment as necessary and providing an asphaltic concrete surface, possibly with ADB funding.

3.4.2 Route 6A

Route 6A, a 44.5 km road from the Chroy Chang Va Bridge in Phnom Penh to its junction with Route 6, is currently under reconstruction with funding from the Japan International Cooperation Agency. All 26 bridges along this road have been reconstructed, and paving works are expected to be completed by October 1995. The entire road was built on a high embankment (3 to 5 m) which has been retained. The finished road will consist of a 7 m asphaltic concrete roadway, with two 1.5 m shoulders.

3.4.3 Route 6

The 29.5 km section of Route 6 in the project area, from the junction with Route 6A to the junction with Route 7, currently consists of a penetration macadam surfaced roadway, about 5.5 m wide, in fair to good condition, with 0.5 to 2 m shoulders. Embankment height varies from 3 to 5 m in the first 10 km, to 0 to 1 m in the last 10 km. Future plans include either rehabilitation of this section to a 6 m wide DBST surfaced roadway with two 1.5 m shoulders or complete reconstruction with an asphaltic concrete surface, similar to Route 6A. Discussions are currently underway with regard to possible funding sources.

3.4.4 Route 7

The first 45 km section of Route 7, from the junction with Route 6 to Kompong Cham, currently consists of a penetration macadam surfaced roadway, about 6 m wide, in fair condition, with 0.5 to 1.5 m shoulders, constructed on low embankments. It is planned to reconstruct this section and surface it with an asphaltic concrete pavement. Discussions are underway for possible external financing.

The next 2 km section consists of streets within Kompong Cham. Over the following 8 km, starting at the Tonle Bet ferry landing on the east bank of the Mekong, the road consists of a penetration macadam roadway, about 5 m wide, in fair to poor condition, with gravel shoulders 0.5 to 1 m wide, in poor condition. Over the next 4.7 km to the junction with Route 11, Route 7 essentially consists of a gravel roadway (it used to be

penetration macadam), averaging 5.4 m in width, in good condition, with gravel shoulders averaging 1.5 m, also in good condition. For the first 5 km from Tonle Bet, the road is constructed on an embankment about 4 m high; for the remaining 7.7 km to the junction with Route 11, the road is practically at ground level.

Beyond the junction with Route 11, the road becomes practically a gravel road in poor condition (deteriorated penetration macadam), built nearly at ground level. At Krek, some 40 km east of the Route 11 junction, the road splits, with the main branch designated as Route 7 continuing in a northward direction towards Laos, and another branch designated as Route 72 continuing southward towards Viet Nam.

3.4.5 Route 11

The total length of Route 11 is 91 km. The 60 km section from Prey Veng (km 31) to the junction with Route 7 is currently being rehabilitated and widened to a 6 m roadway surfaced with DBST and two 1.5 m shoulders, with ADB funding. Also, plans have been approved for rehabilitation of the remaining 31 km section between Prey Veng and Neak Loeng.

At the time of the Study Team visit in mid-May 1995, the section from Neak Loeng to the southern entrance of Prey Veng (km 30) consisted of a penetration macadam roadway about 4.5 m wide (due to erosion), in fair condition, with two shoulders averaging 0.6 m in width (also due to erosion), in poor condition. This section was built on embankments with an average height of 2 m.

The section from the northern exit of Prey Veng (km 31) to km 51 was in an intermediate stage of rehabilitation, consisting at the time of the reconnaissance of a 6 m gravel base roadway with two 1.5 m gravel shoulders, built in general on embankments with heights of 0.5 to 3 m. The section from km 52 to km 72 consisted of a 4.5 to 5 m wide penetration macadam roadway, generally in very poor condition to the extent that in many areas it had deteriorated to a gravel surface. The shoulders ranged from 0.5 to 1 m. Embankment height averaged 1.5 m for the first 10 km, and 2.5 m for the last 10 km. The section from km 72 to km 91 was built at ground level, and consisted of a penetration macadam or gravel roadway in poor condition, on average 5.7 m wide, with two shoulders averaging 0.9 m each, also in poor condition. For about 9 km this section passed through a rubber plantation.

3.4.6 Route 315

Route 315 has a length of 60 km. For the first 32 km from Prek Tamak to Snay Pul, Route 315 consists of a laterite road in generally fair to poor condition. The roadway width generally varies from 4 to 6 m, averaging 5.2 m, and the shoulder width ranges from 0.5 to 1.5 m, averaging 0.9 m. In this section, the roadway is built on low embankments of typically 1 m or less, including some sections at ground level, except for a 3 km section after Prek Tamak which is built on a 2 to 3 m high embankment.

The section from km 32 to km 51 is built on a low embankment, on average about 0.3 m high. This road section has experienced severe erosion, and over a large part of it traffic

trails off the original road. The total combined width of "roadway" and "shoulders" is about 5.5 m. Over the last section of Route 315 from km 51 to km 60, the road transforms into 3 m wide winding trails that are impassable during heavy rainfall and for some time thereafter.

3.4.7 Route 151

Route 151 from the Svay Chrum ferry landing to Prek Tamak, a distance of about 20.5 km, is situated near the east bank of the Mekong and passes through a series of small villages. It is an earth road at ground level, in poor condition, with a roadway 5 to 7 m wide, and shoulders 0 to 1 m wide.

3.5 Bridge Inventory Survey

A bridge inventory survey was conducted simultaneously during the carrying out of the road inventory survey in May 1995 to evaluate the physical condition of bridges along the following project area roads: Route 1 from Phnom Penh to Neak Loeung; Route 6A; Route 6 from the junction with Route 6A to that of Route 7; Route 7 from the junction with Route 6 to Kompong Cham and from Kompong Cham to the junction with Route 11; Route 11; and Route 315.

Bridge inventory work included identification of the following:

- bridge location on a map;
- bridge length, total width, carriageway width and number of spans;
- bridge type;
- superstructure type (e.g., reinforced concrete, steel, timber);
- substructure type (e.g., reinforced concrete, timber pile);
- pavement type (e.g., asphalt, concrete, timber);
- condition of bridge superstructure, substructure, and pavement; and
- photograph record.

The result of bridge inventory survey is summarized in Table 3.1.

3.5.1 Route 1

This route is now under rehabilitation from Phnom Penh to Neak Loeung, financed by ADB. In this section, there are five bridges whose lengths are each less than 30 m. Some of these bridges are equipped with gates for irrigation; some are equipped with tenter gates for irrigation.

Table 3.1: Summary of Bridge Inventory Survey

Route No.	Number of Bridges	Total Bridge Length (m)	Description	Remarks
Route 7	2	181.10	There is one large Bailey bridge with a length of 165.5 m, located approximately 5 km from Kompong Cham; his bridge seemingly does not have sufficient load capacity; it needs to be replaced.	From Kompong Cham to the junction with Route 11
Route 11	19	764.23	One large Bailey bridge with a length of 106 m, located about 7 km from the Neak Loeung ferry station; load capacity seems to be insufficient for existing traffic (especially for log-carrying trucks). Most of the 19 bridges located along Route 11 are old Bailey bridges.	
Route 315	14	554.12	There are two timber bridges which can only accommodate light vehicles with maximum loads of 500 kg; the bridge lengths are 90 m and 126 m. This route passes through a flood area; therefore the number of existing bridge are not sufficient to accommodate through traffic during the rainy season.	
Route 315/B2	12	284.70	This route passes through a relatively density populated zone, so there are many bridges within the route length of only 20 km.	
Route 6A	26	936.00	Rehabilitation works on Route 6A will be completed by Autumn 1995 by Japan Grant Aid. There are 26 reinforced concrete bridges with a common width of 12 m along Route 6A. This route runs along the west side of the Mekong River.	
Route 6	1	147.95	The existing bridge condition is seemingly poor even though very heavy vehicles are currently traversing it.	
Route 7	7	93.10	Bridge conditions are almost the same as those for Route 6. Over-loaded truck hauling logs pass through Route 7 in convoy as well as along Route 6.	From the junction with Route 6 to Kompong Cham
Route 1	5		Route 1 between Phnom Penh and Neak Loeung is undergoing rehabilitation work financed by ADB. The existing 5 bridges seem durable enough for current traffic.	

3.5.2 Route 6A

Route 6A from Phnom Penh to the junction with Route 6 is under rehabilitation, funded by Japanese grant aid. There are 26 reinforced concrete bridges along this route, and all of them have adequate load capacity.

3.5.3 Route 6

The section from the junction with Route 6A to the junction with Route 7 was surveyed. The existing bridge conditions are quite poor even though heavy trucks hauling timber are frequently observed on this route.

3.5.4 Route 7

There are seven bridges on the section from the junction with Route 6 to Kompong Cham, and two bridges on the section from Kompong Cham to the junction with Route 11. There is one bridge located 60 km east of Kompong Cham with a length of 166.5 m. This bridge is a Bailey bridge with three reinforced concrete piers; the loading capacity appears insufficient for heavy vehicles.

3.5.5 Route 11

From Neak Loeng to the junction with Route 7, there are 19 bridges of various type (i.e., Bailey, reinforced concrete, and steel girder). Some of these bridges have suffered serious deterioration at the abutments, which urgently require rehabilitation work. Nevertheless, during the bridge inventory survey, several heavy trucks hauling timber passed over these bridges. Judging from the loading capacity of these bridges, most of them should be replaced to safely satisfy present and future traffic demand.

3.5.6 Route 315

There are 14 bridges along Route 315, including Bailey, steel girder, and timber bridges. Considering that this route passes through a flood area, the number of bridges is not sufficient during the rainy season. Two timber bridges, 90 m and 126 m respectively, cannot support loads greater than 500 kg; they are used only by pedestrians, NMVs, and motorcycles.

3.5.7 Route 115

There are 12 bridges, including both reinforced concrete and timber bridges. One timber bridge with a length of 50 m has suffered serious deterioration and should be replaced as soon as possible.

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