E4. Present Condition of Non-Physical Measures

Present condition of non-physical measures for flood protection and drainage improvement is discussed in this chapter.

4.1 Management of Flood Prone Areas

Management of flood prone areas generally comprises two aspects, namely, zoning control and building and development control. As discussed in the previous chapters, although the CNATUC Law has been established to plan and control land use, building and development, it is not effectively functioning. A land use master plan that should be prepared by CATUC has not been prepared.

4.2 Flood Forecasting and Warning, and Flood Defense Activity

Present condition of flood defense activity of Municipality of Phnom Penh is described hereafter.

<u>Decree, Regulations and Procedures</u>

Any basic law on measures against disaster has not been established in Cambodia. Actual administrative flow for measures against disaster in the historical experience is the following according to the record in the 1996 flooding.

(1) Letter from the Minister of Interior to the Governor of the MPP

Referring to a report on May 21, 1996 of Committee in charge of Disaster, a letter has been issued by the Minister of Interior to the Governor of the Municipality of Phnom Penh and governors of all cities and provinces on July 17, 1996 telling that "to be more prepared and protective to any disaster which arise in this year". More concrete suggestions are:

- To inform the residence living in the area that may have danger from any kind of disaster to be more careful to protect it successful.
- The authorities of every level have to consider and keep an eye on every condition to protect disaster that may happen in any case.
- As long as there is disaster, in the city/province, it should be reported to the Ministry of Interior about the size of damage, assistance of province/city.

Accomplishment of the above is requested to be conducted through close cooperation with competent ministry and the people in region. Copies of the letter are sent to the following persons and organizations.

- Cabinet of Samdec Krom Preah, 1st Prime Minister
- Cabinet of Samdec, 2nd Prime Minister
- Council of Ministers
- Directorate in charge of Disaster

(2) Declaration Issued by the MPP

Receiving the letter from the Minister of Interior, the Municipality of Phnom Penh issued "Declaration on the Appointment of Committee and Sub-Committee to Protect Flood" on August 1, 1996.

In the declaration, the committee and sub-committee have been established with their roles.

(a) Article 1

A mixed Committee to protect flood has been established consisting of one Chief (Governor of MPP), four Vice-Chiefs, one Permanent Member and 25 Members (see Table G4-1).

(b) Article 2

A total of four Sub-Committees to protect flood has been formulated.

- Sub-Committee in charge of technique to protect flood
  It consists of one Chief, two Vice-Chiefs, one Permanent Member and seven Members.
- Sub-Committee in charge of rescue and transport
  It consists of one Chief, one Vice-Chief and nine Members.
- Sub-Committee in charge of finding funds, supply and social affairs
  It consists of one Chief, one Vice-Chief, one Permanent Member and 16 Members.
- Sub-Committee in charge of security
  It consists of one Chief, one Vice-Chief and five Members.

(c) Article 3

The role of Committee and Sub-Committees are defined. The Committee has to stay permanently at the Municipality to solve every flooding matter. The Sub-Committees role is to stay permanently and facilitate in accordance to the Committee.

(d) Article 4

This Committee has to set up a permanent assistance group to stay at Phnom Penh City Hall that made up of the following sections:

- Emergency Intervention Section
  It consists of one Chief, one Vice-Chief and 12 Members.
- Statistics and Report Section
  It consists of one Chief, one Vice-Chief and nine Members.
- Funds Raising and Dividing Donations
  It consists of one Chief, one Vice-Chief and nine Members.

Copies of the declaration are sent to the following persons and organizations:

- Council of Minister

- Minister of Interior
- Ministry of Public Works and Transport
- Ministry of Agriculture, Forestry and Fisheries
- Ministry of Economy and Finance
- Personnel on Duty as appointed in this declaration

(3) Declaration to the Residents in the Critical Area

On September 27, when the water level of the Tonle Mekong came up to W.L. of 10.37m, an urgent declaration has been issued to the residents in the critical area for flooding. An official water level to announce the emergency case is W.L. 10.50m. The declaration is issued to call for all people who are living in the critical area to be aware of this disaster so that everyone may prepare oneself ready to keep preserve and escape from it on time.

Copies of the declaration are sent to the following persons and organizations.

- Council of Ministers
- Ministry of Interior
- Ministry of Information
- News Association, TVK
- TV 3, 5, 9, 11
- Cambodian National Radio

<u>Activities of the Committee and Sub-Committees for Flood Protection</u>

A report on flood protection activities has been submitted from the Governor of the MPP to Co-Minister in charge of Council of Ministers, Co-Minister in charge of Ministry of Interior and Secretary General in charge of Disaster.

- On August 8, 1996 had the meeting among Committee and Sub-Committee to provide duty to the Department of Agriculture, MPP is to take responsible for northern part of Phnom Penh, the Department of Public Works and Transport, MPP is to take responsible for southern part as well as to build 18,400 m dam started from Monivong bridge until road leading to Kop Srov dam.
- Making the announcement to people in Phnom Penh to be aware of flood and be ready to protect it in some case that may arise. MPP had also advised the government institutions to safeguard 24 hours in 24 hours.
- On September 9, 1996 wrote a letter to request budget amount Riel 214,505,506 from National Committee in charge of disaster.
- On September 23, 1996 had the meeting again among the Committee and Sub-Committees to make emergency plan due to water level of Mekong River reaches the maximum height enough to broadcast an announcement.
- Had written letters to private company for machinery to protect flood.
- Had written letters to the Ministry of Public Works and Transport to help warn the ship, motor boat not to drive fast along the river, which causes harmful or damages to river bank and newly built dam.
- Had written letters to three districts surrounding the city to prepare boat to help people.

- Had written letters to every ministry, secretariat, department, district to safeguard at its own place which divided by MPP.

Flood Defense Works in 1996 Flood

The first phase of flood defense was concentrated on two areas, namely, Chbar Ampov in Mean Chey District and Chroy Chang Var District in Russey Keo District.

In Mean Chey District, the local authorities built Chbar Ampov Dam but the level of Tonle Mekong was too strong to break it at 8:00 on September 28, 1996, therefore the flood covered all over the vegetable market of Chbar ampov.

In Russey Keo District, a dam was built along the Tonle Mekong from Svay Chrom to Kbal Chroy, however the flood of Tonle Mekong broke through this dam at 24:00 on September 29, 1996 and then it flooded all over Sangkat Chroy Chang Var and Sangkat Prek Tasek.

The second phase, from September 29, concentrated was for the three places

- Kop Srov dam
- Along national road starting from Monivong bridge to Prek Phnov
- Boeng Tompun dam

Works are the following:

(1) Kop Srov Dam

A total of 92 trucks of land that covered along Kop Srov dam to stop the seepage through seepage hole "dragon hold" was filled and also sacks of soil are put on the slope of the dam. Machinery was introduced to fill the seepage hole.

(2) Along national road starting from Monivong bridge to Prek Phnov

A total of 30 trucks of soil was put to cover the low land areas.

(3) Boeng Tompun Dam

A total of 119 trucks of soil was put along Boeng Tompun dam to stop seepage through seepage hole ("dragon hold") and sacks of soil were put on the slope of the dam.

Evaluation and Recommendation on the Flood Defense Activities in 1996

The Municipality of Phnom Penh evaluated by themselves the flood defense activities in 1996 as follows:

(1) Good Points

Good points (advantages) are:

- Had set up the Committee and Sub-Committee for flood protection on time.
- Had good cooperation with other constitutions, companies and the people.
- It was well organized in setting up groups.

- The experience in 1991 and 1994 remained good results for the activities in 1996.
- Ministries, Departments, public establishments, and individuals helped to protect the flood on time

(2) Weak Points

Weak points (disadvantages) are:

- Shortage of budget to pay for emergency cases, such as means, materials.
- Shortage of budget to repair Kop Srov dam and Boeng Tompun dam, which are the belt of city core to protect flood and threatens people every year.

E5. Recommendation for Institutional Improvement

5.1 Organizational Improvement

The Executing Agency for the component projects of the Master Plan will be the Municipality of Phnom Penh. The Municipality of Phnom Penh will hold the final responsibilities for direction setting and decision making involved in proceeding the implementation of the project, with reference of important matters to the Government as may be necessary.

Within the MPP, Department of Public Works and Transport is the technical department in charge of the project. DPWT will be the implementing body. As one of subordinating organization under the management of DPWT, Drainage and Sewage Division (DSD) is the agency specifically responsible for the management and operation of drainage improvement issues in the master plan.

An organization responsible for flood protection is not clear in the present organizational structure. Accordingly, creation of Flood Protection Division under the DPWT is recommended. Flood Protection Division will be in charge of implementation of Kop Srov and Tompun Dikes Reinforcement in technical aspect. Proper operation and maintenance work is also important task.

(1) Creation of Flood Protection Division in DPWT

The duties assigned and the proposed organization of the Flood Protection Division are as follows:

(a) Duty

- In charge of construction of flood protection dikes and related facilities
- In charge of maintenance of flood protection dikes and related facilities and of flood protection function of roads
- Conduct activities e.g. patrol, give warning to isolated people, give technical advise for protecting dike from break

(b) Organization and Number of Staffs

The proposed organization and number of staffs are shown in Figure E5-1.

(2) Improvement in Drainage and Sewerage Division

Necessary staffs and their numbers for each construction, and operation and maintenance period will be as discussed in the article of operation and maintenance plan.

5.2 Capacity Building for River Engineering and Flood Protection

Capacity building especially for basic knowledge for DPWT staffs is presently conducted through "Institutional Capacity Building Component and the Neighborhood Improvement Program" as a part of Phnom Penh Water Supply and Drainage Project Part B. After the

creation of a division responsible for flood protection, capacity building in the river engineering field is necessary.

(1) Objective

The objective of the capacity building is to heighten the knowledge in the river engineering and disaster prevention fields, and use the knowledge for the construction, operation and maintenance of the flood protection facilities and to minimize flooding disaster.

(2) Courses

Field

- River engineering
- Design of flood protection dikes and riverine structures
- Construction supervision of flood protection works
- Operation and maintenance of riverine structures
- Flood defense activities
- Similar projects in the foreign countries
- Etc.

Possible Input

- Seminar or workshop with foreign experts and lecturers
- On-the-job training in the course of the project implementation
- Group training in foreign countries

5.3 Establishment of Laws and Regulations

Laws and Regulations

Various laws and regulations should be developed. The following will be taken into consideration.

- Water law or river law
- Law that regulates domestic and industrial wastewater disposal to rivers or sewerage systems
- Regulations for sewerage fee and its use
- Official development plan for MPP including a land use plan or a zoning plan
- Flood disaster crisis management
  - A basic law on disaster measures
  - An act for flood fighting
  - A law on fire defense system
  - An act for the disaster relief
  - Review of disaster prevention related article of the police laws
  - Review of disaster prevention related article for the national defense related laws

Of these, high priority should be given to the following:

- Decree for sewerage fee collection and its use, and,

- Preparation of the official land use plan for the MPP

Decree for sewerage fee collection and its use is closely related to secure sustainable operation and maintenance of the drainage system.

The "Land Use Master Plan" should be prepared as soon as possible following CNATUC Law. There found illegal and uncontrolled development at many locations and they destroy the water retention capacity of the suburban areas. Refer to the Sub-section 2.7.1 for more concrete discussion.

Guidelines

Technical guidelines that should be prepared include the following:

- Planning criteria and design manuals for flood control facilities
- Planning criteria and design manuals for drainage and sewerage works

Operation and Maintenance Manual

Operation and maintenance manuals should be prepared for each structure. Those for the structures of priority projects will be prepared in the detail design stage.

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- Review and Assessment of the Department of Roads and Major Construction, MPWT and Selected Provincial and Municipal Public Works and Transport Departments, Feasibility Study for Selected Priority National/ Provincial Roads, World Bank, JOC-OCC, December 1996

Table E2-1 Budget of Operation and Maintenance Works by DSD of DPWT

1994

Item		Amount (Riel)	Remarks
1	Sewage work	282,600,000	Contract price
2	Pumping station		
	(a) Maintenance work	23,000,000	Spare-parts
	(b) Pleration work	623,000,000	Electricity & diesel oil
	Sub-total	646,000,000	
Total		928,600,000	US$1=2,500Riels

1995

Item		Amount (Riel)	Remarks
1	Sewage work	737,800,000	
2	Pumping station		
	(a) Maintenance work	18,500,000	
	(b) Pleration work	789,000,000	Electricity & diesel oil
	Sub-total	807,500,000	
Total		1,545,300,000	US$1=2,700Riels

1996

Item		Amount (Riel)	Remarks
1	Sewage work	40,000,000	
2	Pumping station		
	(a) Maintenance work	41,000,000	
	(b) Pleration work	976,000,000	Electricity & diesel oil
	Sub-total	1,017,000,000	
Total		1,057,000,000	US$1=2,750Riels

1997

Item		Amount (Riel)	Remarks
1	Sewage work	192,600,000	
2	Pumping station		
	(a) Maintenance work	45,900,000	
	(b) Pleration work	774,200,000	Electricity & diesel oil
	Sub-total	820,100,000	
Total		1,012,700,000	US$1=3,100Riels

Table E3-1 Organization of Committee and Sub-Committee for Flood Control (1/4)

Article 1: Had appointed the mixed committee to protect flood as followings:

No.	Name	Title	Position
1	H.E Chhim Seak Leng	Delegation of the Phnom Penh Royal Government	Chief
2	H.E Chea Sophara	First-vice governor of Phnom Penh Municipality	Vice-Chief
3	H.E Kry Beng Hong	Vice-governor of Phnom Penh Municipality	-ditto-
4	H.E Chap Nhaly Vuth	-ditto-	-ditto-
5	H.E Khouv Menghean	-ditto-	-ditto-
6	Captain Neth Savceun	Commissioner of Police, Phnom Penh Municipality	Member
7	Colonel Neam Ieng	Commander of Royal Military Police	-ditto-
8	Captain Prom Din	Commander of Special Military Region	-ditto-
9	Mr. Mann Chhoeun	Chief of Cabinet, Phnom Penh Municipality	Permanent Member
10	Mr. Tiv Kim Piseth	Deputy-Chief of Cabinet, Phnom Penh Municipality	Member
11	Mr. Sok Leakena	-ditto-	-ditto-
12	Mr. Nuon Someth	-ditto-	-ditto-
13	Mr. Kim Soy Samalen	-ditto-	-ditto-
14	Mr. So Victor	-ditto-	-ditto-
15	Mr. Keo Savin	Director of Public Works & Transport Department	-ditto-
16	Mr. Phat Leng	Director of Agriculture Department	-ditto-
17	Mr. Ngeth Chakdavy	Director of Economy and Finance Department	-ditto-
18	Mr. Sin Sok	Director of Urbanization & Construction Department	-ditto-
19	Mr. Chhuan Sothy	Chief of Cadastral Office	-ditto-
20	Mr. Um Hoeung	Director of Education, Youth and Sport Department	-ditto-
21	Mr. Chan Pho	Director of Commercial Municipality	-ditto-
22	Mr. Veng Thay	Director of Health Department	-ditto-
23	Mr. Chea Son	Head of Social Affairs Department	-ditto-
24	Mr. Vann Soun	Vice-Head of Planning Committee	-ditto-
25	Mr. Youk Chhea	Head of Information Department	-ditto-
26	Mr. Touch Sarun	Governor of (Khan) Mean Chey District	-ditto-
27	Mr. Krouch Phan	Governor of Dang Kor District	Member
28	Mr. Seng Rathanak	Governor of Russey Keo District	-ditto-
29	Mr. Los Ry	Governor of Cham Kar Mon District	-ditto-
30	Mr. Nuth Chea	Governor of Toul Kork District	-ditto-
31	Mr. Pal Buy Bunnang	Governor of 7 Makara District	-ditto-
32	Mr. Soun Rindy	Governor of Daun Penh District	-ditto-

Article 2 : Had appointed the Sub-committee to protect flood as in the followings:

A. Sub-committee in charge of technique to protect flood:

No.	Name	Title	Position
1	H.E Kry Beng Hong	Vice-Governor of Phnom Penh Municipality	Chief
2	Mr. Ke Vouch Leng	Deputy Director of Public Works and Transport	Vice-Chief
3	Mr. Phat Leng	Director of Agricultural Department	-ditto-
4	Mr. Mann Choeun	Chief of City Hall Cabinet	Permanent Member
5	Mr. Kruach Pharn	Governor of Dangkor District	Member
6	Mr. Seng Rathanak	Governor of Russey Keo District	-ditto-
7	Mr. Touch Sarun	Governor of Mean Chey District	-ditto-
8	Mr. Eng Nguon	Head of Road and Bridge Division	-ditto-
9	Mr. Nhem Saran	Official in charge of General Administration	-ditto-
10	Mr. Chheang Ran	-ditto-	-ditto-
11	Mr. Mao Chharth	-ditto-	-ditto-

Table E3-1 Organization of Committee and Sub-Committee for Flood Control (2/4)

B. Sub-committee in charge of rescue and transport:

No.	Name	Title	Position
1	H.E Chap Nhaly Vuth	Vice-Governor of Phnom Penh Municipality	Chief
2	Mr. Keo Savin	Director of Public Works and Transport Department	Vice-Chief
3	Colonel Chea Sarin	Deputy Commander of Royal Military Police	Member
4	Captain Khem Chea Saroeun	Deputy Commander of Special Military Region	-ditto-
5	Captain Kong Saran	Deputy Commissioner of National Police	-ditto-
6	Mr. Kim Soy Samalen	Deputy Chief of City Hall Cabinet	-ditto-
7	Mr. Ouw Lay	Deputy Governor of Russey Keo District	-ditto-
8	Mr. May Mon	Head of Dangkor District Department	-ditto-
9	Mr. Uon Hun	Deputy Governor of Mean Chey District	-ditto-
10	Mr. Som Punary	Official in charge of Economy & Finance of the Department	-ditto-
11	Mr. Ngeth Ken	Official in Charge of General Administration	-ditto-

C. Sub-committee in charge of finding funds, Supply and Social affairs:

No.	Name	Title	Position
1	H.E Chea Sophara	First Vice-Governor of Phnom Penh Municipality	Chief
2	Mr. Ngeth Chakdavy	Director of Economy and Finance Department	Vice-Chief
3	Mr. Tiv Kim Piseth	Head of Coty Hall Cabinet	Permanent Member
4	Mr. Chan Pho	Director of Commerce Department	Member
5	Mr. Vann Suon	Vice-Head of Planning Committee	-ditto-
6	Mr. Youk Chhea	Head of Information Department	-ditto-
7	Mr. Suon Rindy	Governor of Dawn Penh District	-ditto-
8	Mr. Los Ry	Governor of Cham Kar Mon District	-ditto-
9	Mr. Nuth Chea	Governor of Toul Kork District	-ditto-
10	Mr. Pal Buy Bunnang	Governor of 7 Makara District	-ditto-
11	Mr. Chea Son	Head of Social Action Department	-ditto-
12	Mr. Veng Thay	Director of Health Department	-ditto-
13	Mr. Um Hoeung	Director of Education Department	-ditto-
14	Mr. Nuon Someth	Vice-Chief of City Hall Cabinet	-ditto-
15	Mr. Chin Poa	Vice-Head of General Administration	-ditto-
16	Mr. Uk Kheang	Head of Protocol Office	-ditto-
17	Mr. On Neang	Vice-Head of Protocol Office	-ditto-
18	Mr. Heng Vantha	Vice-Head of Accounting Office	-ditto-
19	Mr. Prak Chouth Maneth	Official in the General Administration	-ditto-

D. Sub-committee in charge of Security:

No.	Name	Title	Position
1	H.E Khouv Menghean	Vice-Governor of Phnom Penh Municipality	Chief
2	Neth Savoeun	Commissioner of Phnom Penh Police	Vice-Chief
3	Khem Cheasavoeun	Vice-Commander of Special Military Region	Member
4	Mr. Phuang Syphin		-ditto-
5	Mr. Sok Leakhena	Chief of Phnom Penh City Hall Cabinet	-ditto-
6	Mr. So Victor	-ditto-	-ditto-
7	Mr. Sao Kun Chhon	Vice-Head of General Administration Office	-ditto-

Table E3-1 Organization of Committee and Sub-Committee for Flood Control (3/4)

Article 3 : The role of mixed-Committee and Sub-Committee

The Mixed-Committee has to stay permanently at the Municipality to solve every flooding matters. The Sub-Committee's role is to stay permanently and facilitate in accordance to the above mentioned.

Article 4 : This committee has to set up one permanent assistance group to stay at Phnom Penh City Hall, which made up of the following sections:

A. Emergency Intervention Section:

No.	Name	Title	Position
1	Mr. Mann Chhoeun	Chief of Cabinet, City Hall Phnom Penh	Chief
2	Mr. Um Mareth	Head of Administration Office	Vice-Chief
3	Mr. So Phanara	Vice-Head of Administration Office	Member
4	Mr. Kaeth Syving	-ditto-	-ditto-
5	Mr. Sok Suy	Secretary to Delegation of Phnom Penh Royal Government	-ditto-
6	Mr. Kim Soy Samalen	Chief of City Hall Cabinet	-ditto-
7	Mr. So Victor	-ditto-	-ditto-
8	Mr. Nak Danavuth	Vice-Head of International Relation	-ditto-
9	Mr. Heng Vantha	Vice-head of Accounting Office	-ditto-
10	Mr. Bun Serey	-ditto-	-ditto-
11	Mr. Leng Chuan	Head of Protection Police, Cabinet of City Hall	-ditto-
12	Mr. Top Seiha	Official at General Administration Office	-ditto-
13	Mr. Lim Vichet	Official at International Relation Office	-ditto-
14	Mr. Bay Tharith	-ditto-	-ditto-

B. Statistics and report section:

No.	Name	Title	Position
1	Mr. Tiv Kim Piseth	Chief of City Hall Cabinet	Chief
2	Mr. Mok Samnang	Vice-Head of General Administration Office	Vice-Chief
3	Mr. Chheng Chan Vantha	-ditto-	Member
4	Mr. Sao Kun Chhon	-ditto-	-ditto-
5	Mr. Slouth Sambun	Officials at General Administration Office	-ditto-
6	Mr. Neang Theam	-ditto-	-ditto-
7	Mr. Prak Chout Maneth	-ditto-	-ditto-
8	Mr. Chea Kong	-ditto-	-ditto-
9	Mr. Kim Boran	-ditto-	-ditto-
10	Mr. Chheang Van	-ditto-	-ditto-
11	Mr. Mae Sary	Official at International Relation Office	-ditto-

Table E3-1 Organization of Committee and Sub-Committee for Flood Control (4/4)

C. Funds raising and dividing donations:

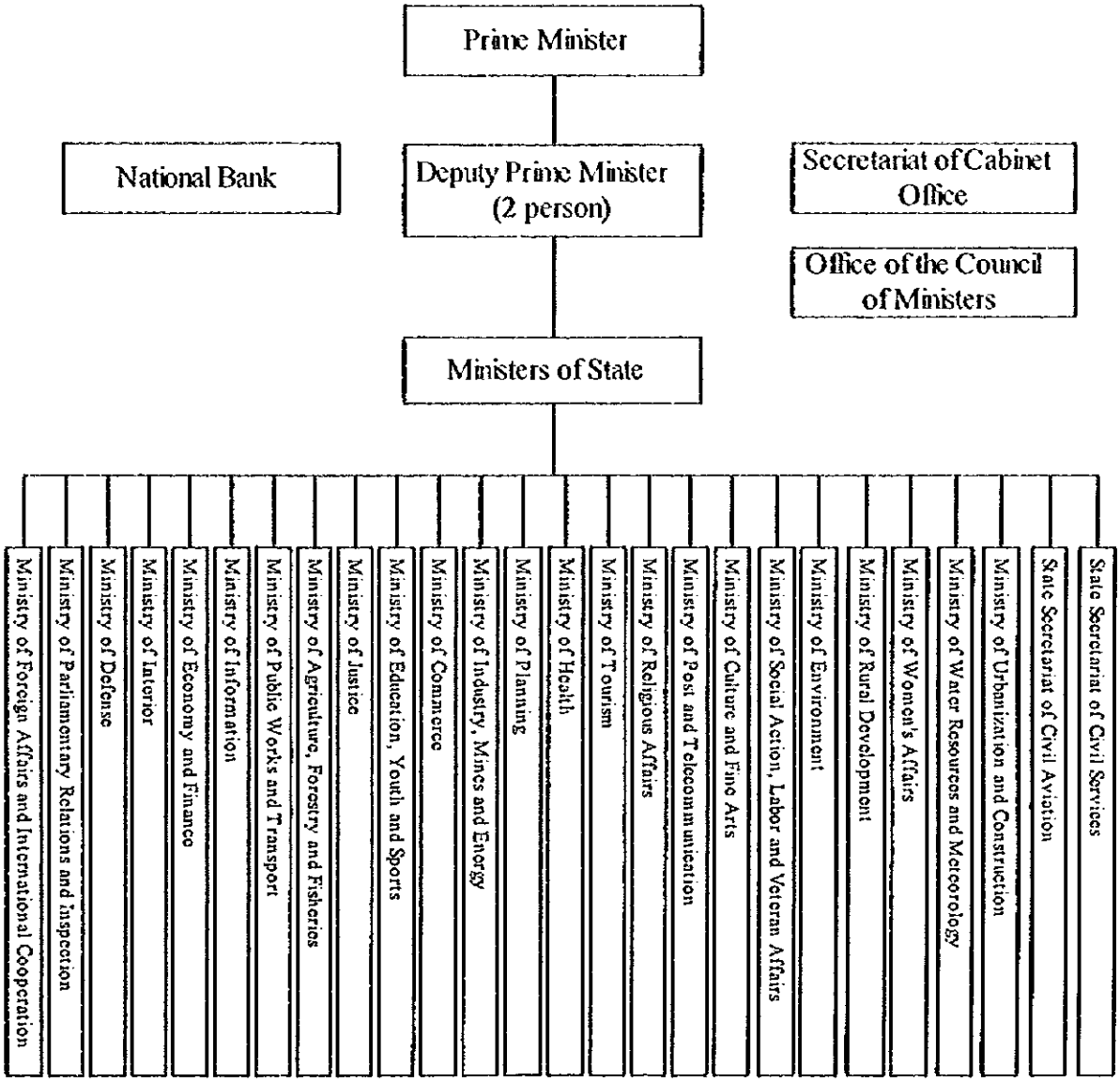
No.	Name	Title	Position
1	Mr. Sok Leakhena	Vice-Head of City Hall Cabinet	Chief
2	Mr. Nuan Someth	-ditto-	Vice-Chief
3	Mr. Uk Kheang	Head of Protocol Office	Member
4	Mr. Chin Poa	Vice-Head of General Administration Office	-ditto-
5	Mr. Orn Neang	Vice-Head of Protocol Office	-ditto-
6	Mr. Mao Sam R	Vice-Head of International Relation Office	-ditto-
7	Mr. Sleung Sovan	Official at General Administration Office	-ditto-
8	Mr. Uk Sakhorn	-ditto-	-ditto-
9	Mr. Chuap Nang	-ditto-	-ditto-
10	Mr. Keo Vong Rathanak	-ditto-	-ditto-
11	Mr. Haw Meng Hong	Official at Investment Office	-ditto-

Article 5 : Chief of City Hall Cabinet, Commissioner of Phnom Penh Police, Commander of Special Military Region, Deputy Commander of Military Police, Director of Public works and Transport Department, Director of Agriculture Department, Director of Economy and Finance Department, Director of Urbanization and Construction, Director of Health Department, Directorate of Social Action and Veterans, Director of Education, Youth and Sport, Director of Agricultural Department, City Planning Committee, Head of Cadastral Municipality, All of District Governors and everyone as mentioned in Article 1, Article 2 and Article 4 has to accomplish one's own duty successfully from the date of signature.

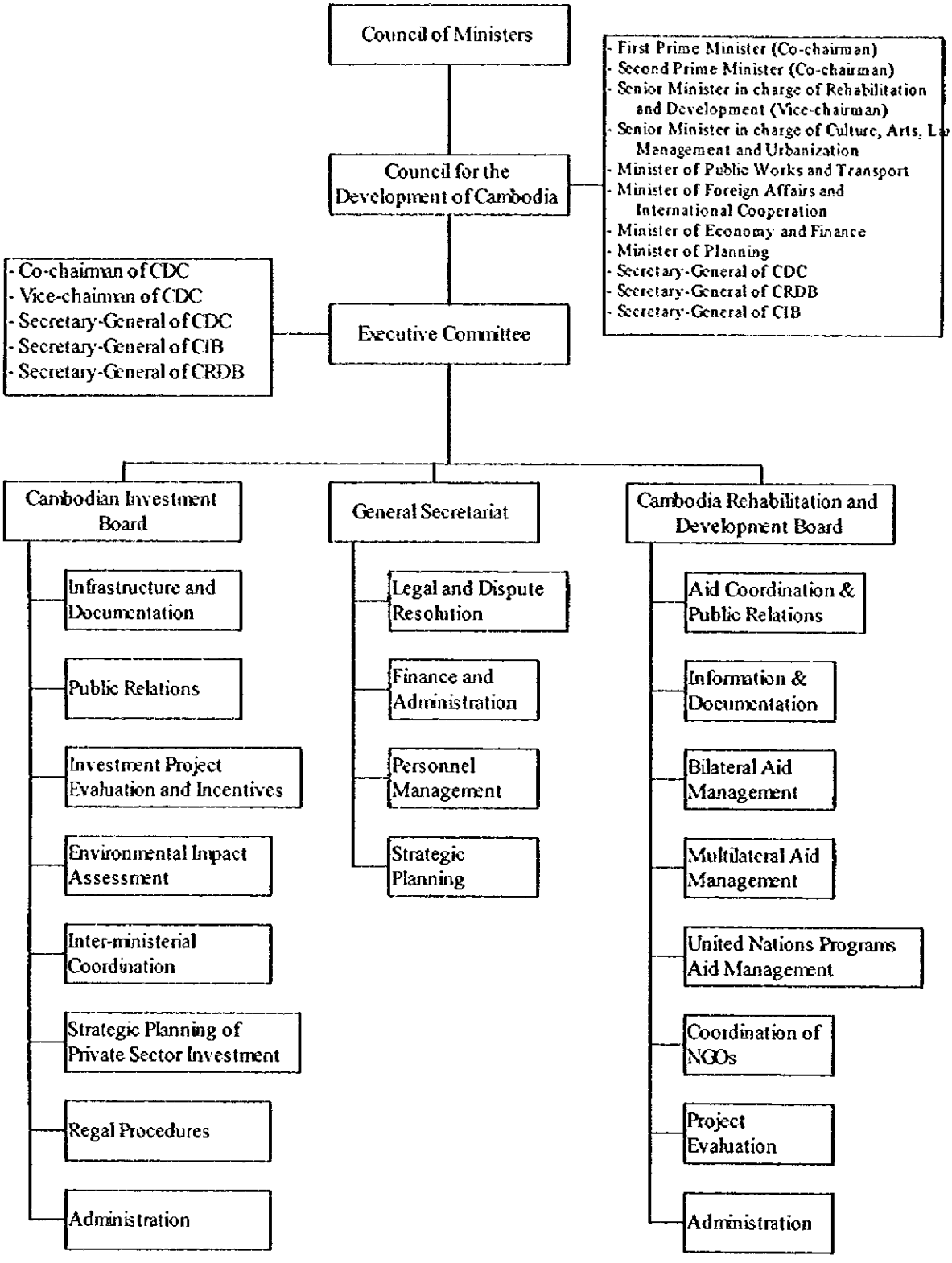
Delegation of Phnom
Penh Royal Government

Signature by Governor,
Chhim Seak Leng

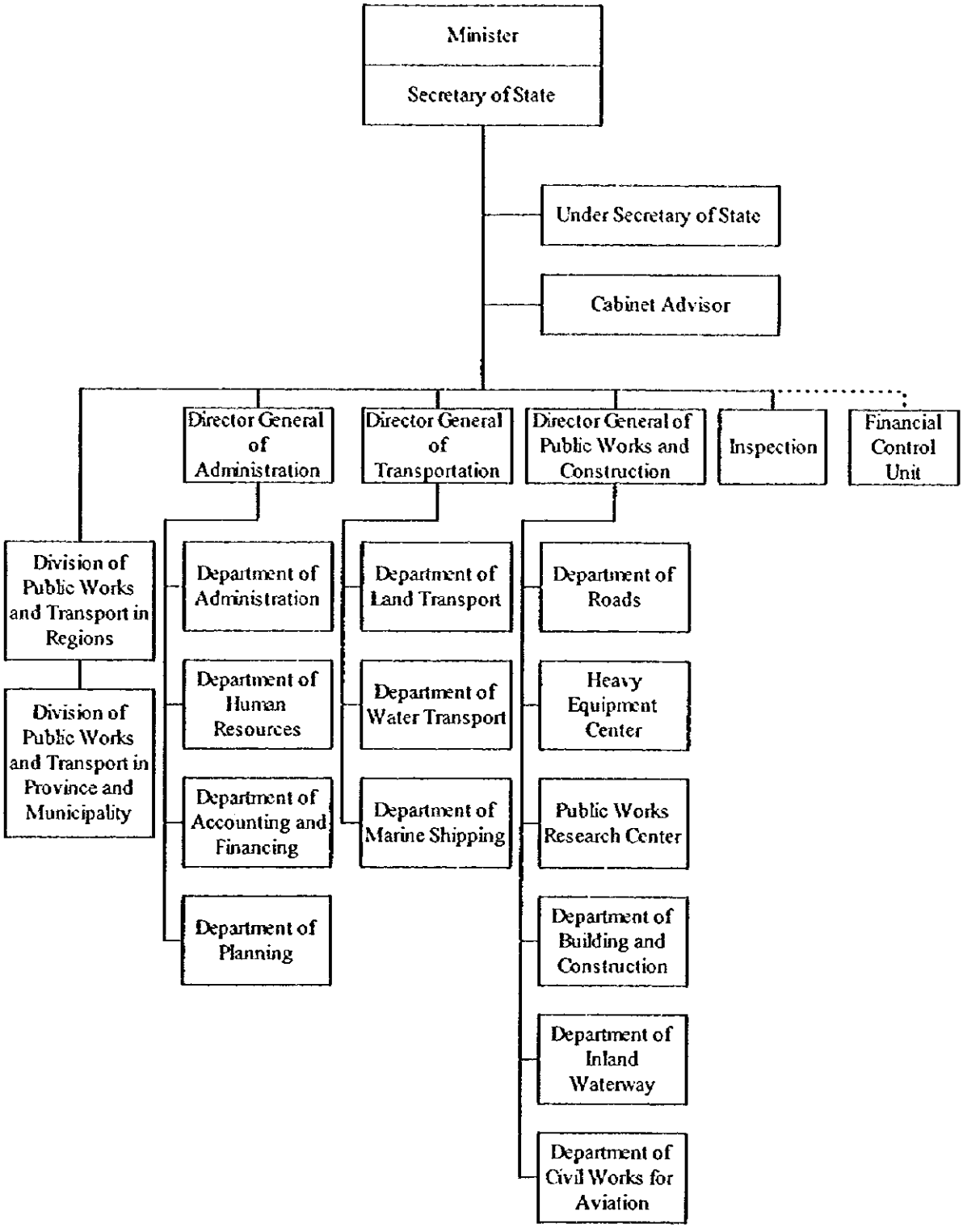
cc:
- Council of Minister
- Minister of Interior
- Ministry of Public Works and Transport
- Ministry of Agriculture, Forestry and Fishery
- Ministry of Economy and Finance
- As mentioned in Article 5. "For duty"
- Document



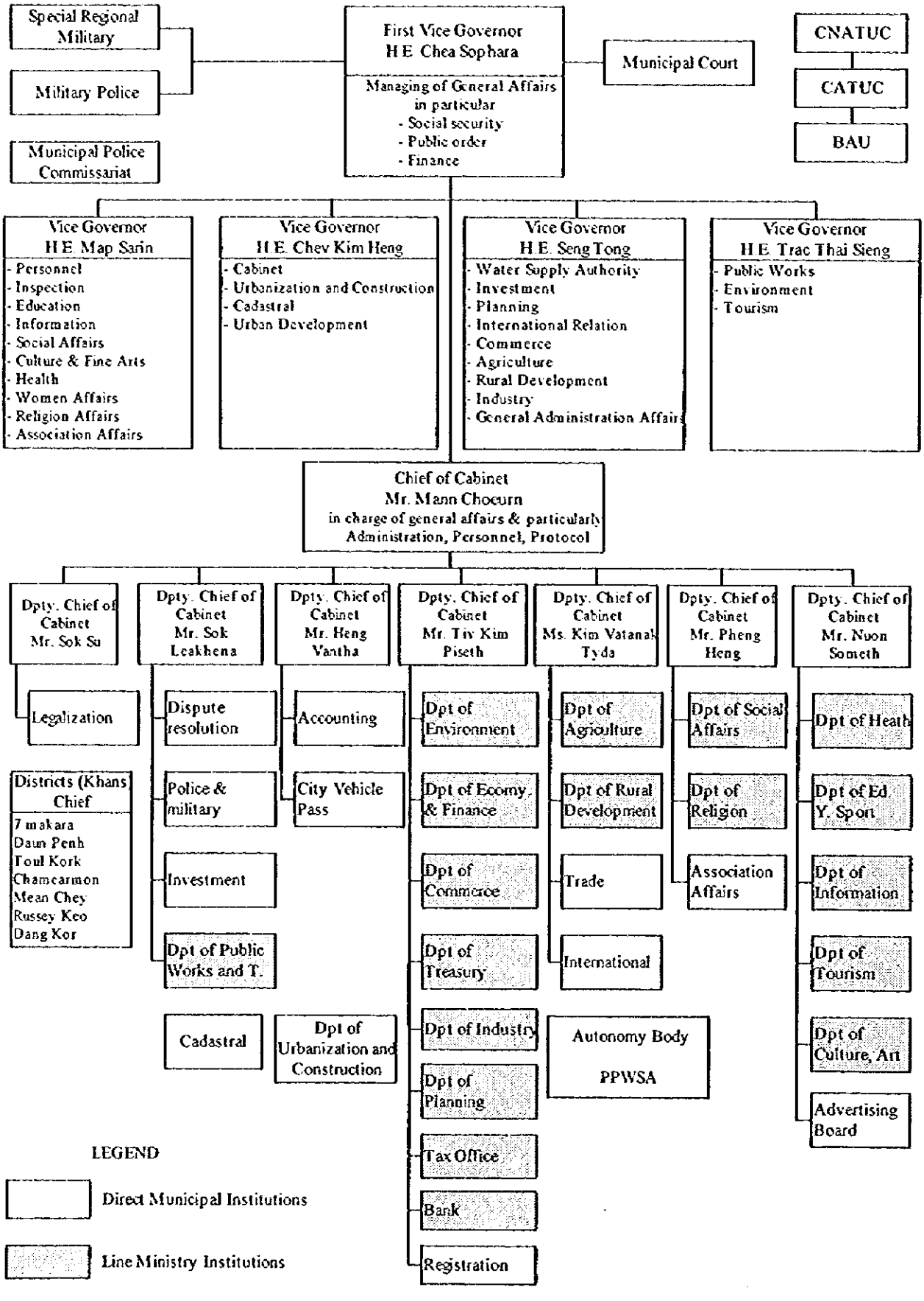
The Study on Drainage Improvement and Flood Control in the Municipality of Phnom Penh JICA-CTIE International Co., Ltd. -Nippon Koei Co., Ltd.	Figure E2-1 Organizational Chart of the Cambodian Government



The Study on Drainage Improvement and Flood Control in the Municipality of Phnom Penh JICA-CTIE International Co., Ltd. -Nippon Koei Co., Ltd.	Figure E2-2 Organizational Chart of Council for the Development of Cambodia (CDC)

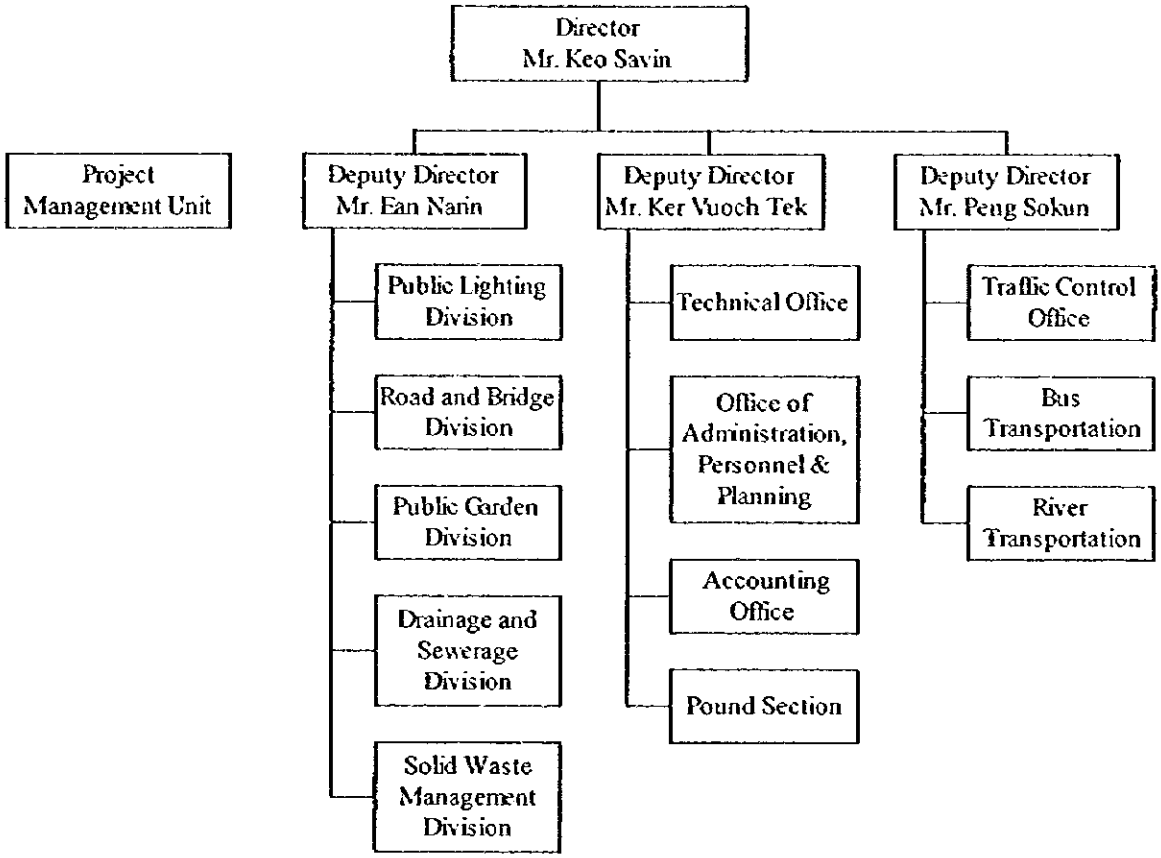


The Study on Drainage Improvement and Flood Control in the Municipality of Phnom Penh JICA-CTIE International Co., Ltd. -Nippon Koei Co., Ltd.	Figure E2-3 Organizational Chart of Ministry of Public Works and Transport (MPWT)

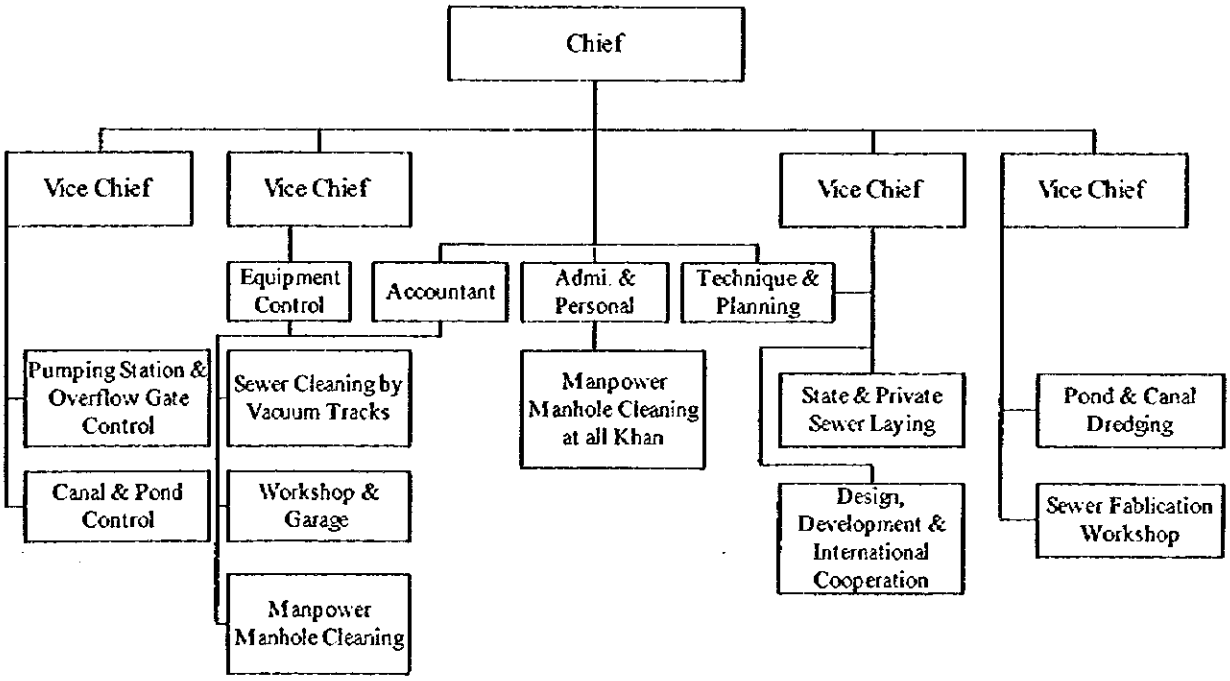


The Study on Drainage Improvement and Flood Control in the Municipality of Phnom Penh JICA-CTIE International Co., Ltd. -Nippon Koei Co., Ltd.	Figure E2-4 Organizational Chart of the Municipality of Phnom Penh

Organizational Structure of Department of Public Works and Transport

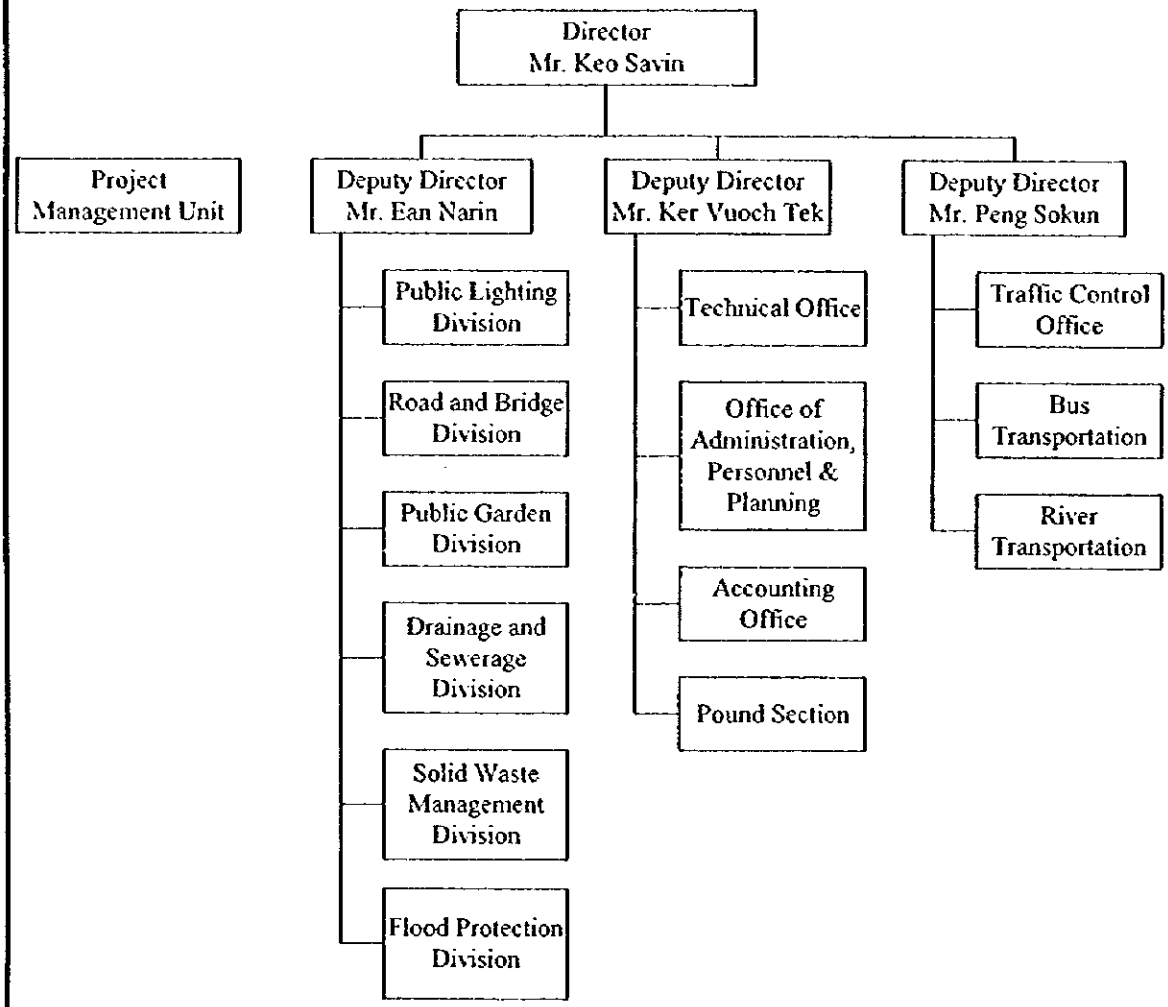


Organizational Structure of Drainage and Sewage Division

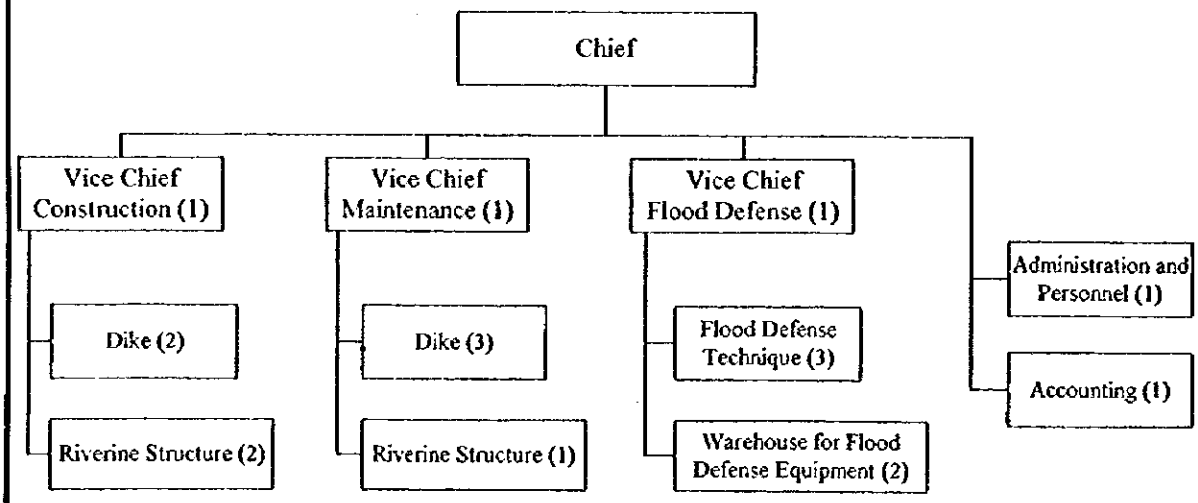


The Study on Drainage Improvement and Flood Control in the Municipality of Phnom Penh JICA-CTIE International Co., Ltd. -Nippon Koei Co., Ltd.	Figure E2-5 Organizational Chart of Department of Public Works and Transport (DPWT) and Drainage and Sewage Division (DSD)

Organizational Structure of Department of Public Works and Transport



Organizational Structure of Flood Protection Division



The Study on Drainage Improvement and Flood Control in the Municipality of Phnom Penh JICA-CTIE International Co., Ltd. -Nippon Koei Co., Ltd.	Figure E5-1 Proposed Organizational Chart of Department of Public Works and Transport (DPWT) and Flood Protection Division

Sector F

Socioeconomy

THE STUDY ON
DRAINAGE IMPROVEMENT AND FLOOD CONTROL
IN THE MUNICIPALITY OF PHNOM PENH

SECTOR F: SOCIOECONOMY

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F1. Introduction

This Supporting Report, Sector F "Socioeconomy" describes the results not merely of socioeconomic study but of economic and financial analyses of proposed projects for the Study on Drainage Improvement and Flood Control in the Municipality of Phnom Penh. The Report is composed of the following chapters:

(a) F1. Introduction: this chapter;

(b) F2. Present Condition and Challenges: mentions socioeconomic background of Cambodia, Phnom Penh City and the Study Area, and challenges in socioeconomic development now going on;

(c) F3. Economic and Financial Analyses of Mater Plan: deals with economic and financial analyses for the projects suggested by the Master Plan; and

(d) F4. Economic and Financial Analyses of Priority Projects: presents the results of economic and financial analyses, in terms of feasibility study level, for the priority projects identified through the Master Plan.

F2. Present Condition and Challenges

2.1 Cambodia in Brief

After decades of civil wars, Cambodia started to reconstruct the country in 1993 under a new coalition government with a market economy system. With the assistance of the international community, the Cambodian government has been actively promoting administrative and financial reforms and development of infrastructures. The present socioeconomic condition of Cambodia is, however, characterized by still low level of economic and social standards. Table F2-1 compares the socioeconomic condition in Cambodia with those of neighboring countries.

Cambodia has a population of about 10 million, about double of Laos, but 14 % and 17 % each of those of Vietnam and Thailand. Cambodia is situated between the two populous countries in the east and west. Gross national product (GNP) per capita of Cambodia at US$ 270, according to the World Development Report 1997 by the World Bank, is comparable to Laos and Vietnam with US$ 350 and US$ 240 respectively, all classified as the lowest income economies. Cambodia's GNP per capita at US$ 270 is equivalent to 10 % of Thailand (US$ 2,740), which experienced a remarkable economic growth in the last 10 years. Reflecting the smaller population size and lower per capita income level, the size of economy in terms of GDP (US$ 2,771 million in Cambodia) is about 2 % of Thailand's GDP at US$ 167,156 million.

Cambodia as well as Laos is highly dependent on the agriculture sector with agriculture value added accounting for 51 % of GDP (52 % in Laos), while that in Thailand is only 11 %. Vietnam is less dependent on agriculture with 28 %. The other side of the coin is lower level of industrialization in Cambodia with the manufacturing sector value added accounting for only 6 % of GDP.

In the social aspect, Cambodia still lags behind the other countries. Illiteracy in Cambodia is 35 %, while those in Vietnam and Thailand are 6 %. That in Laos is higher at 43 %. Infant mortality rate is highest in Cambodia at 108 deaths per 1,000 births, while those of other countries are 90 (Laos), 41 (Vietnam) and 35 (Thailand). The rate of schooling is also low in Cambodia compared with the other three countries: only less than half of primary school age children going to school in Cambodia.

Following the economic reforms launched since 1989 aiming at liberalization of prices and international transactions, the Cambodian economy showed a recovery at a fairly high pace. As shown in Table F2-2, GDP growth rates exceeded 7 % per year in 1991 and 1992. After a slowdown from 1993 to 1994, the economy expanded at a high rate at 7.6 % per year in 1995. The growth in 1996 was reduced to 6.5 % per year, still fairly a good performance. This fall in growth rate in 1996 is explained by damages by floods from September to October, leading to drop in crop production. Until 1996, the engine for fast GDP growth were such sectors and sub-sectors as the manufacturing (garment industry with foreign capital and local small scale industries) and the service sector (restaurants, shops, hotels and trade related activities).

In 1997, however, the economic growth is estimated to be down to about 2.0 % as a result of the political crisis in July. While the agriculture sector remained unaffected with a

growth rate of 5.2 %, the industry and service sectors were severely affected with growth rates reduced to 0.6 % and minus 0.4 % respectively. The prospect for 1998 is unfortunately not very bright. The economic crisis started in the second half of 1997 in neighboring Asian countries will inevitably affect the Cambodian economy. Much of the foreign investments, that have been leading the growth of the Cambodian economy in the last several years, originates in the suffering Asian countries such as Malaysia, Hong Kong and South Korea. It is highly possible that the number of investors with sufficient capital to be able to make investment in Cambodia is now much more limited compared with the pre-crisis period. Weakening currencies of these countries and other Asian countries will also adversely affect the number of tourists to Cambodia. Considering these factors, the economic growth in 1998 could remain at the 1997 level.

2.2 Phnom Penh City

The major socioeconomic characteristics of Phnom Penh City is presented in Table F2-3 and summarized below:

Socioeconomic Characteristics of Phnom Penh

Item	Values	
Land area	290.06	km^2
Population (registered)	872	thousand
Population (total)	1,000	thousand
Sex composition of population		
- Male	47	%
- Female	53	%
Population density	3,006	persons/km^2 (registered population)
Population growth (1986-1996)	3.2	%/year
Household size	5.7	persons/household
Population under 20 years of age	54	%
Migrants	43	% of total population
Unemployment	6.5	%
Labor force structure		
- Agriculture	13	%
- Industry	14	%
- Service	74	%
Average household expenditure	781	thousand Riel (1993-1994)

Phnom Penh has a registered population of 872 thousand as of March 1998. The actual population including non-registered population is said to be around 1 million. Phnom Penh's population accounted for 7.7 % of the national population in 1996. As is the case in Cambodia, female population accounts for 53 % of the total population, the result of long-lasting civil wars and genocide years. Accordingly, female-headed households account for 28 % of all the households in Phnom Penh, unusually high compared with other Asian countries. The population of Phnom Penh grew at 3.2 % per year since 1986, slightly higher than the national population growth at 3.0 % per year.

The manufacturing value added generated in Phnom Penh accounted for 20 % of the national manufacturing value added in 1993, seeming intuitively low. In 1998, the share should be higher than this, as a result of accelerated foreign direct investments in the manufacturing sector concentrated in Phnom Penh since 1993. As a reflection of the

Phnom Penh's role as the industrial and commercial center of Cambodia, the labor force structure is characterized by a high proportion of the industry and service sectors, both combined accounting for 88 % of the total labor force.

Significant proportions of the Phnom Penh's population are migrants from other provinces, recorded at 43 % of the total population. The main reason for moving is related with seeking a job in Phnom Penh. Unemployment in Phnom Penh is high at 6.5 %, while that in Cambodia is 0.9 %. These facts imply that while people move to Phnom Penh looking for job, there are not sufficient job opportunities in Phnom Penh, resulting in a higher unemployment rate. In Phnom Penh, about 6.2 % of the population is regarded as earning below the poverty line (Riel 1,578 per person per day in 1993/1994 in Phnom Penh).

In the absence of regional income data of Phnom Penh, a preliminary effort was made to estimate gross regional domestic product (GRDP) of Phnom Penh. Table F2-4 shows the result. Labor productivity, value added produced by one worker, in each sector in Cambodia is first derived based on the data on gross domestic products and labor force by sector. Assuming the same levels of labor productivity, GRDP of Phnom Penh is estimated based on the sector-wise number of labor force in Phnom Penh and the derived value added per worker in Cambodia for each sector. The following points are clarified:

- The Phnom Penh's GRDP is estimated to be Riel 1,218 billion in 1996, accounting for 15% of the Cambodia's GDP.
- The industrial and service sectors combined account for 97 % of the GRDP, a sharp comparison with Cambodia with both sectors combined accounting for 56 % of GDP and remaining 44 % produced by the agriculture sector. *
- GRDP per capita in Phnom Penh is estimated to be US$ 562 per capita in 1996, about 87 % higher than GDP per capita of Cambodia at US$ 301.*
- Reflecting the dominant share of the industrial and service sectors, the growth of Phnom Penh's GRDP was remarkable even including the year 1997. An average growth rate of GRDP is estimated to be 8.9 % per year during the 1990 –1997 period.

* The values of sectoral distribution of GDP and GDP per capita shown here are taken from Table F2-2, whose figures are different from the World Bank report figures presented in Table F2-1.

In reality, it is likely that the Phnom Penh's GRDP is greater than the estimate above, reflecting the possibly higher labor productivity of economic activities in Phnom Penh. With the absence of data concerning the difference in labor productivity, however, the estimate above is used as proxy.

2.3 Study Area

The Phnom Penh's city boundary extends beyond the study area boundary. Out of the city's total area of 290.06 km², 90 km² is out of the study area. The population in the study area is estimated to be about 817 thousand in 1998, both registered and non-registered. Excluding the population in the sub-districts totally outside the study area and counting only the portion within the Study Area by area proportion for the sub-districts lying across the city boundary, it is found that about 81.7 % of the Phnom Penh's population lives within the Study Area boundary. These sub-districts are found in

Dangkor, Meanchey and Russey Keo districts. The number of households is estimated to be about 143 thousand assuming 5.7 members per household. Figure F2-1 shows the boundaries of Phnom Penh City, Study Area and the districts. Table F2-5 presents population in the seven districts and those in the sub-districts in the outlying three districts.

Population in the areas to be affected by the priority projects is estimated based on the population by sub-districts. The following are the derived population in 1998.

- Northeast, Northwest and Middle Area (Component 2): 227 thousand
- Tompun Watershed (Component 3) : 269 thousand

The population in those sub-districts lying across the boundaries of affected areas are allocated in rough proportion to areas within and outside the affected areas. The proportion of the non-registered population is assumed to be 22 % of the registered population, based on the proportion estimated for Phnom Penh City. Table F2-6 and F2-7 presents a detail of the estimate of the population above.

2.4 Challenges in Socioeconomic Development

Existing Development Plans

A number of challenges await Cambodia in maintaining economic growth and alleviating poverty. As part of the government's effort to manage and promote economic growth in a coherent and efficient manner, a number of documents such as follows have been prepared:

- First Five Year Socio-Economic Development Plan 1996 – 2000 (hereafter SEDP);
- Public Investment Programme, 1996 –1998, 1997-1999 and 1998 – 2000 (hereafter PIP); and
- Policy Framework Paper 1997 - 1999.

In order to clarify the major challenges awaiting the Cambodia's socioeconomic development, SEDP and PIP 1998-2000 as well as a World Bank report entitled "Cambodia, Progress in Recovery and Reform, June 2 1997" (hereafter the WB report) are reviewed. The findings are summarized in the following part.

Major Challenges in Socioeconomic Development

(1) Economic Development Targets

Reflecting the overall good economic performance until 1996, the existing economic development targets and prospect are assumed based on an optimistic view and with the characteristics as a base target for policy formulation. The following are the assumed targets and prospects in the rate of economic growth. Table F2-8 presents the major socioeconomic development targets, which are summarized below:

- SEDP : 7.5 % per year between 1996 and 2000
- PIP 1998-2000 : 7.0 % per year between 1998 and 2000
- WB report : 7.1 % per year for 1999 - 2001
  7.6 % per year for 2002 - 2006

These targets will be a basis for establishing a socioeconomic framework for the present study at a later stage. Inflation rate is set at 5 % per year. Reflecting the government policy of achieving a balanced budget, the proportion of government revenue to GDP is assumed to rise from 9.9 % in 1996 to 11.6 % in 2000 and 16.9 % by 2006.

(2) Tight Fiscal and Monetary Policy

The government will continue adopting a tight fiscal and monetary policy to maintain the Cambodian macro-economy in a stable condition and gain momentum in growth. This direction will be sought through implementing various reforms in administration, tax system, legal foundation, and the financial sector structure. The number of civil servants and expenditure on defense and security, accounting for 55 % of the current expenditure in 1997, will be reduced such that more funds become available for other important purposes in tackling poverty and bringing about economic growth. Tax reforms aim at expanding taxation base as well as improving the tax collection mechanism. This will be an important measure to increase government revenue. An appropriate legal framework provides a secure environment for business activities, an important prerequisite for a market economy. The financial sector reform aims at building a "two-tier system", in which the central bank concentrates on monetary policy and supervising private banks, whereas private banks are engaged in commercial financial transactions. "Dedollarization" would be an important direction in strengthening the central bank's effectiveness in monetary policy.

(3) Public Investment Plan

Public investment plays a vital role in achieving economic growth and improving people's living standard. Physical infrastructure needs to be upgraded such that new investments are attracted and the existing business can operate efficiently. Development of social infrastructure would contribute to upgrading living environment for people.

The Cambodian government prepared the first Public Investment Programme (PIP) in 1995 for the following 1996-1998 three years. Since then the program has been updated every year and the latest version is the Public Investment Programme 1998-2000. Currently, as of June 1998, preparation work is going on for the PIP 1999-2001. The PIPs list up projects and programs, both investment programs and survey programs, and put priority to them depending on their funding status and investment efficiency. Projects and programs need to be processed and included in the PIPs in order to be financed by the national budget. The PIP unit in the Ministry of Planning serves as the secretariat. An inter-ministerial steering committee is set up, chaired by the Ministry of Planning and joined as members by the Ministry of Economy and Finance, Council for the Development of Cambodia, and National Bank of Cambodia. The PIPs include projects and programs which are ongoing, committed and those neither ongoing nor committed but judged to have high priority. Other projects and programs with lower priority are not included in the PIPs.

Table F2-9 presents sectoral allocation of the PIP 1998-2000. A total of US$ 1.2 billion for three years is estimated in the PIP 1998 – 2000 with the following allocation:

PIP 1998 - 2000

(Unit : US$ million)

Item	1998	1999	2000	Total
Capital Investment	171	268	355	794
Technical Assistance	133	134	139	406
Total	304	402	494	1,200

(4) Private Investment

Most of the envisaged economic growth will be derived from accelerated and expanded activities in the private sector. The government role will be confined to that of a facilitator, improving and developing an environment more favorable for private sector activities. On this basis, the government will implement a number of software and hardware measures such as mentioned above. It is estimated by the WB report that increased private investment will result in the share of private investment in GDP rising from 14.5 % in 1995 to 18.2 % by the year 2006.

(5) Capacity Building

For promoting Cambodia's development, assistance from abroad will be indispensable for some years to come. In the development process, however, an effort should be continued to internalize skills and technologies. A sustainable development in a long run will be attained only with Cambodian people playing the central role. Strengthening education, from basic education to higher education as well as vocational and technical training will be vital in this regard. SEDP sets forth the following targets in educational development by the year 2000:

- 65 % of 12 year-old children complete grade 6 and become functionally literate and numerate. In 1994, only 13 % of primary school children complete grade 5 in five years.
- 50 % of 16 year-old girls are enrolled in grade 10. In 1994, there were only 19 % female students at this level.

The PIP 1998-2000 assumes a spending of US$ 56 million per year in the education sector.

F.3 Economic and Financial Analyses of Master Plan

3.1 Economic Analysis of Master Plan

3.1.1 Economic Benefit

Methodology

Economic benefit is estimated by measuring the reduction of flood and inundation damage by implementing the proposed master plan. The following steps are taken:

(a) Formulation of socioeconomic framework

(b) Calculation of direct damage for building properties and assets

- Calculation of standard number of building in a mesh by land use type
- Calculation of values of buildings and assets
- Estimation of floor level by land use
- Calculation of damage values for mesh by land use and inundation depth

(c) Calculation of indirect damage

(d) Calculation of damages for livestock, fishery and agriculture production

(e) Estimation of flood and inundation damages by selected rainfall return period for with- and without- project conditions and conversion to annual average economic benefit by flood and inundation mitigation

The following part explains each of these steps.

Socioeconomic Framework

A socioeconomic framework is formulated for Phnom Penh City and the Study Area. The established socioeconomic framework provides basic conditions for forecasting land use characteristics for the year 2010. The following summarizes the established socioeconomic framework:

Socioeconomic Framework of Phnom Penh and Study Area

Item	Phnom Penh		Study Area		Growth Rate (%/year)
	1996/98*1	2010	1996/98*1	2010	
Population ($\times 10^3$)*2	1,000	1,451	817	1,192	3.2
GRDP (US$$10^6$)*3,*4	313.9	829.6	257.4	680.3	7.2
Industry	(69.8)	(230.4)	(57.3)	(188.9)	(8.9)
Service	(234.6)	(581.5)	(192.4)	(476.8)	(6.7)

Note: *1 Population in 1998, GRDP in 1996
*2 Population in Phnom Penh and the Study Area include both registered and non-registered population
*3 US$ = Riel 3,880 is applied
*4 GRDP (Gross Regional Domestic Product) in the Study Area is assumed to be 82% of the Phnom Penh's, applying the population proportion

Table F3-1 presents the assumptions applied in projecting the Phnom Penh's population. The overall population growth rate at 3.2 % per year between 1998 and 2010 is divided into 2.4 % per year natural growth and remaining 0.8 % per year social growth. The natural growth rate of 2.4 % is taken from the national population projection until 2025, assuming the same natural growth rate in Cambodia and Phnom Penh. The social growth rate is estimated by converting the forecast labor force in 2010 to population. The idea is that the number of labor force required to achieve the target economic growth rates is to be met partly by natural population increase and the remaining by population inflow into Phnom Penh. The population in the Study Area, accounting for 82 % of the Phnom Penh's population, is assumed to grow at the same rate as in Phnom Penh.

Table F3-2 shows a process in working out the economic growth targets. The economic growth targets for Phnom Penh are worked out integrating the Cambodia's economic growth targets stipulated in the Socio-Economic Development Plan (SEDP) 1995-2000 and the actual growth targets in 1996 and 1997. These target economic growth rates are assumed to be driven by an increase in the number of labor force and a rise in labor productivity, production per a labor, half by half. Thus, the number of labor force is assumed to grow half the rate of the sector growth rates. The number of labor in 2010 is estimated in this way and input into the population projection.

Direct Benefit for Buildings and Assets

Direct benefit is calculated as the difference in flood and inundation damages with and without the project condition. For the present project, inundation damage is divided into those for building properties and assets and those for livestock, fish pond and agriculture.

(1) Building Properties and Assets

Values of flood and inundation damages on building properties and assets are obtained based on the following factors:

- Standard number of each building type in a mesh for respective land use type;
- Values of buildings and assets; and
- Damage ratio.

These values have been calculated as follows.

(a) Standard Number of Building in a Mesh by Land Use Type

The standard numbers of each building type are assumed for respective land use type as shown in Table F3-3. The assumptions applied are shown in Appendix I. The number of meshes for each land use type are derived based on the analysis on land use pattern in 1998 and 2010 as presented in Sector A "Land Use and City Planning". The number of buildings by type in a mesh in 1998 are estimated based on an analysis on the existing land use characteristics and most likely pattern envisaged. The number of buildings in 2010 are set by adjusting the 1998 numbers so that the total number of buildings in the Study Area to be derived are consistent with the population and economic growth rates worked out in the Socio-Economic Framework. The number of

households is assumed to grow at the same rate as the population growth at 3.2 % per year. For other types of buildings than houses, an increase in the number of buildings and assets is assumed to contribute 50 % to an increase in the total values of building and assets. The remaining 50 % is assumed to result from a rise in the values per building and assets. A process of this calculation is sown in Table F3-4. The number of buildings is thus estimated as follows:

Number of Buildings in 1998 and 2010

Type	1998	2010
House	143,000	209,000
Shop	3,584	5,225
Factory	535	878
(Small)	(354)	(581)
(Large)	(181)	(297)
Warehouse	134	195
Office	438	639
School	105	153
Hospital	24	35

(b) Values of Buildings and Assets

The average values of buildings and assets are obtained based on the result of the Asset and Flood Damage Survey (hereafter " AFDS ") conducted from May to June 1998 by TEAM Consulting Engineers Co., Ltd. and information on the market prices of commodities. An outline of the AFDS results is presented in Appendix II. Appendix III presents an estimate of the values of assets owned by households and others, based on a price survey carried out at shops and markets from May to June 1998 in Phnom Penh. The average values on buildings and assets obtained by the AFD Survey are analyzed and partly adjusted to correct for the sample-based survey results. A coefficient of 0.79 is derived as shown in Table F3-5, meaning the level of average household income in Phnom Penh is 79 % of the income level of the households surveyed by AFDS. This coefficient is applied to the values of houses and households assets. The values of other types of buildings are taken from the results of AFDS without adjustment. The values of buildings and assets are thus estimated as shown in Table F3-4 and F3-6. The following values are applied to the present analysis:

Assets Values in 1998 and 2010

(Unit: $)

Type of Building	Building		Asset	
	1998	2010	1998	2010
House	3,008	3,400	890	1,000
Shop	4,800	7,100	800	1,100
Factory				
Small	9,000	15,200	11,300	19,100
Large	57,600	97,600	72,600	123,100
Warehouse	12,500	18,600	3,400	5,000
Office	10,000	14,900	8,800	13,100
School	100,000	100,000	7,800	7,800
Hospital	22,000	22,000	11,400	11,400

* Small: factories with workers less than 10
Large: factories with workers equal or more than 10 workers

(c) Damage Ratio

The damage ratios applied in Japan are applied to the present analysis. Table F3-7 shows the applied damage ratios.

The inundation damages estimated applying these damage ratios are cross-checked with the damage values declared by interviewees of AFDS in order to assess the appropriateness of the assumptions applied to estimating inundation damage. AFDS revealed the average floor levels and the levels of inundation depth in 1995 and 1996 floods. Based on these values, water levels are classified into inundation below floor level and that above floor level. The latter is further classified into ranges of depth above floor level. The average inundation levels reported were found to be either below floor inundation or inundation above floor level within 0.5 meter. The damage ratios applied in estimating damage values correspond to these reported inundation levels.

The following table presents the result of a comparison between the estimated and the surveyed average damage values per building. Table F3-8 presents a detail of the comparison. The surveyed damage values in the table below are the averages of those in 1995 flood and 1996 flood:

Comparison of Surveyed and Estimated Inundation Damage Values to Building and Assets

(Unit: $/case)

Item	Compared Level of Inundation	a. Survey	b. Estimate	b/a
Household				
Building	<0.5 m above floor	348	277	0.80
Asset	<0.5 m above floor	161	129	0.80
Shop				
Building	below floor level	213	154	0.72
Asset	below floor level	60	26	0.43
School				
Building	below floor level	4,497	3,200	0.71
Asset	below floor level	4,844	3,482	0.72
Small factories				
Building	<0.5 m above floor	5,000	828	0.17
Asset	<0.5 m above floor	0	1,040	-
Other		768	0	0.00
Warehouse				
Building	<0.5 m above floor	0	1,150	-
Asset	<0.5 m above floor	0	313	-
Other		988	0	-
Office				
Building	<0.5 m above floor	5,000	920	0.18
Asset	<0.5 m above floor	0	810	-
Other		564	0	-

Note:
Survey : Values surveyed by Asset and Flood Damage Survey conducted by TEAM Consulting Engineers Co., Ltd. as part of the present study.
Estimate : Values estimated by the Study Team

Concerning household, shop and school, proportions of the estimated values to the surveyed values range from 0.43 to 0.80, indicating that the estimated values are on the conservative side. A comparison of the remaining three categories, small factories, warehouse and office, is constrained by limited numbers of samples. The average damage values to building for small factories and office are affected by a few special cases with high damage values. Damage values to asset for the three categories and that to building for warehouse are reported to be none. This would not reflect the reality in that there should be damages to buildings and assets in a long-run, if not felt immediately at the time of inundation. There also should be damages actually taking place, but not covered by the survey.

The damage ratios as presented in Table F3-7 are applied to the present analysis, judging them as the best possible alternative.

(d) Floor Level

Data on average floor levels were obtained by AFDS as follows:

Average Floor Levels by Building Type

(Unit: meter)

Item	Average Floor Level
Household	0.54
Shop	0.29
Office	0.39
Factory	0.18
Warehouse	0.12
School	0.72

The average floor levels for each building type obtained are weighed by the proportions of inundation damage values for respective land use category. This gives the average floor levels for respective land use type as follows:

Average Floor Levels by Land Use

(Unit: meter)

Land Use Type	Average Floor Level
1. Dense activities	0.19
2. Dense urban center	0.47
3. Dense residential	0.46
4. Loose residential	0.50
5. Loose activities	0.40
6. Agriculture land, unused land	0.50
7. Fishpond	0.54

(e) Total Damage to Buildings and Assets

The values of direct inundation damage are derived for a 200-meter by 200-meter mesh for each land use type and by level of inundation as presented in Table F3-9.

Indirect Benefit

AFD Survey revealed that there are a number of problems caused by inundation in addition to those on interviewees' buildings and assets such as inconvenience in transportation and water supply and health problems. There were many respondents who experienced no damage on their assets, but expressed their expectation for the improvement in inundation condition. This indicates that many people suffer form inundation apart from damages on their own property.

For the objectives of grasping magnitude of indirect benefit of flood and inundation mitigation, interview surveys with the district offices and infrastructure and utility organizations were carried out from November to December 1998. The following part presents an outline of the findings.

(1) Interview results with District Offices

Interview surveys were conducted at seven district offices of the Municipality of Phnom Penh: Prampi Makhara, Toul Kork, Dong Penh, Chamkamron, Russey Keo, Dankor and Meanchey. Data were collected in the following aspects:

- Damage on infrastructure and utility facilities;
- Expenditure on restoration work;
- Traffic condition at inundation time; and
- Degradation of urban function.

(a) Damage on Infrastructure and Utility Facilities

The following table and Table F3-10 summarizes the level of damages to various public facilities such as road, bridge, water supply, sewerage, power and telecommunications facilities:

Damages on Infrastructure and Utility Facilities

District	Road	Bridge	Water Supply	Sewerage	Power	Telecomm - unication
Prampi Makhara	2	1	1	3	1	1
Toul Kork	3	no bridge	2	3	1	1
Dong Penh	3	no bridge	1	3	1	1
Chamkamorn	3	no bridge	1	3	1	1
Russey Keo*	3	no bridge	3	1	3	3
Dangkor	3	2	1	1	1	1
Meanchey	2	no bridge	1	2	1	1

Note: 1: No damage, 2: lightly damaged, 3: Severely damaged
* Chroi Chavana sub-district, which is outside the Study Area

In all districts, roads and streets are damaged by inundation. Holes and hollows are made after the inundation degrading the road and street condition.

Sewerage and drainage facilities are also highly damaged. There is much waste disposed at drainage channels and sewers and they are clogged after inundation. Underground sewers are broken when trucks and heavy vehicles pass degraded roads and streets.

Power and telecommunication facilities are not damaged according to the district offices. Information collected at Electricité du Cambodge (EdC) and the Ministry of Post and Telecommunications, however, points out substantial damages caused on power supply and telecommunications facilities as presented later.

(b) Expenditure on Restoration Work

The following table and Table F3-10 gives the expenditures by districts on restoration works after inundation:

Expenditure of District Offices on Restoration Work after Inundation

(Unit $)

District	1997	1998
Prampi Makhara	33,400	7,700
Toul Kork	2,500	44,337
Dong Penh	70,410	2,820
Chamkamorn	185,338	80,925
Russey Keo*	25,020	N/A
Dangkor	47,500	N/A
Meanchey	5,860	0

* Chroi Chavana sub-district, which is outside the Study Area

The amount of expenditure ranges between $2,500 and $185,000, corresponding to 0.5 % to 35 % of Phnom Penh Municipality's expenditure in 1997. Mostly, expenditures are used for restoration of roads and streets and clearing of waste from drainage channels and sewers.

(c) Classification of Roads/Streets by Traffic Condition at Inundation Time

The following table and Table F3-10 present a classification of streets and road by the level of traffic at inundation time and corresponding proportions:

Proportion of Streets/Roads according to Traffic Condition at Inundation Time

(Unit: %)

District	A	B	C	D	Total
Prampi Makhara	0	10	20	70	100
Toul Kork	10	0	80	10	100
Dong Penh	30	30	20	20	100
Chamkamron	20	8	70	2	100
Russey Keo*	100	0	0	0	100
Dangkor	80	0	0	20	100
Meanchey	0	0	80	20	100

Note: Case A: No traffic can pass. Case B: Only high floor vehicles can pass. Case C: All vehicles can pass, but at slower speed. Case D: Normal

* Chroi Chavana sub-district, which is outside the Study Area

A pattern observed in such districts as Prampi Makhra, Toul Kork, Chamkamron and Meanchey seems to be reasonably reflecting the overall condition of each district. In these districts, Case C ("All vehicles can pass, bur slowly") and D ("Normal) account for most of the cases, whereas Case A ("No vehicles can pass") and B ("Only high floor vehicles can pass") are 0 % to 30 %. A pattern observed in Russey Keo and Dangkor seems to be reflecting the condition at severely inundated area in the district, in stead of the condition of the whole district. A pattern in Dong Penh with an almost even distribution needs clarification.

(d) Degradation of Urban Function

The following table and Table F3-10 present judgments by district officers on the level of downgrading of urban functions at inundation time. Percentages are given in proportion to 100 % as the normal condition when there is no inundation:

Degradation of Urban Functions

(Unit : %)

District	Normal Inundation	Severe Inundation
Prampi Makhara	90	70
Toul Kork	100	90
Dong Penh	80	70
Chamkamorn	90	50
Russey Keo*	70	30
Dangkor	100	10
Meanchey	100	80

* Chroi Chavana sub-district, which is outside the Study Area

At normal inundation, urban functions are either maintained at the normal level or downgraded down to 70 % to 90 %. At severe inundation, which occurs every year, urban functions fall down to 10 % to 90 % of the normal time. The cases of Russey Keo and Dangkor, however, should be the condition of the inundated area instead of the whole district.

(2) Interview Results with Infrastructure and Utility Organizations

The results of the interview survey with infrastructure and utility organizations are summarized as follows:

(a) Electricité du Cambodge (EdC): Power Company

Power supply in Cambodia is handled by Electricité du Cambodge (EdC). The information collected from EdC reveals that the power supply system is substantially damaged and troubled by inundation. The following troubles are pointed out:

- There is a difficulty in carrying out repair works at inundation time.
- Water running into power boxes and engine can cause electric shock to human life and facilities.
- Power supply is cut by inundation.
- Since many power lines are underground, they are cut by trucks running over at inundation.
- At power stations, explosion of transformer and fire breaks out at machines and safety protectors.

- Power loss increases at transmission lines by explosion, electric shock to human life, fire breaking out in buildings with cable problem and explosion of transformer and protector systems. The quality of power lines is seriously deteriorated.
- Power supply from sub-stations becomes irregular due to inundation.

EdC spent $24,000 in 1997 and $14,000 up to August in 1998 for restoration work of the power supply facilities. Restoration work takes from 6 hours to two days.

Service characteristics of EdC are summarized as follows:

(i) Number of customers

- Residential	:	24,458
- Commercial and service	:	2,413
- Industrial and light industrial	:	135
- Public lighting	:	3

(ii) Volume of power sold: 229.27 GWh in 1997

(iii) Revenue : Riel 80,703.6 million in 1997

(iv) Loss : Riel 12,845.8 million in 1997

(b) Ministry of Post and Telecommunications

Interviews were made at the Ministry of Post and Telecommunications concerning postal service and telecommunications service.

The telecommunication network in Phnom Penh has two elements: the new system installed with the assistance of the Japanese government and the old system. The old system comprises about 60 % of the total system. The new system is not damaged by inundation since the new equipment is resistant to water. The old system, especially the outside plant, is damaged by inundation. The expenditures for restoration works were $ 3,200 in 1997 and $ 4,600 in 1998. The number of days needed to restore the damaged facilities is about 75 days. Total traffic volume in 1997 was 30 million minutes including local calls and long distance calls. The total revenue by telecommunication service was $ 2.0 million in 1997.

Postal service in Cambodia is constrained by limited number of vehicles for delivery. Delivery service is made by hiring taxis, boat and motorcycle taxis. Inundation imposes problem in rural and suburban areas, limiting access to some points. Delivery service in downtown areas is not so troubled. When an area is inundated and it is difficult to reach a certain delivery point, either delivery is made by hiring a boat or the mail returned to the central post office

for re-delivery until the water recedes. In Phnom Penh, inundation causes trouble to postal service more in the surrounding districts of Russey Keo, Dangkor and Meanchey.

(c) Phnom Penh Water Supply Authority (PPWSA)

Generally speaking, there are no damages caused to water supply facilities operated by PPWSA. Treatment plants and pumping facilities are designed to be protected from high water. At present enough pressure is maintained in the pipes, therefore no problem is found such as leakage of water into pipes. Water meters are also designed to be resistant to inundation. Meter reading becomes impossible during inundation, but this is not a serious problem. Based on these conditions, no budget is spared for restoration work after inundation.

Concerning water supply, the problem lies more on the side of individual households. An information at a district office indicated that inundation damages pumps used by households for obtaining water. The Asset and Flood Damage Survey (AFDS) conducted from May to June 1998 clarified that 33 % in 1995 flood and 32 % in 1996 flood of the surveyed households suffered from problems in water supply at inundation. Most of the damages is in the form of contamination of water tank. Most Phnom Penh residents have their own water storage tank due to low pressure in the delivery system. The storage tanks need to be cleaned up after inundation. The same problem occurs for groundwater well.

(3) Estimate of Indirect Benefit

In the present analysis, various indirect benefits of inundation mitigation is assumed to be 30% of the direct benefit estimated above. There are no definite methods of calculating indirect benefits. In reality, however, there are a variety of damages caused by inundation such as those on inventory, infrastructure and utility facilities, sales activities and traffic, expenditure on mitigation and restoration measures, and psychological damages. In Japan, these damages in sum could well exceed 30 % or even 100 % of the direct damages. Table F3-11 shows a preliminary estimate of damage caused by degraded urban function due to inundation. This benefit is roughly equivalent to 8.3 % of the direct economic benefit, which is considered constituting a part of various indirect benefits.

Livestock, Fishpond and Agricultural Production

No damage is likely for livestock and fishpond operators judging from the finding of AFDS. There was a reported case of serious damage in fishpond. It was found that fish feed were damaged by inundation. This kind of damage can be avoided with sufficient precaution measure like most other fish pond operators are practicing.

Economic benefit in agriculture production is estimated for rice, since other crops such as vegetables and maize were found to be cultivated in the areas outside the Study Area in Phnom Penh City. Damages on agriculture production is estimated, therefore, for rice production in the meshes classified as "agricultural land" in the land use plan for 2010. The following assumptions and basic conditions are set in estimating agriculture benefit:

Assumptions for Rice Production Benefit Estimate

Item	Inundation by Dike Breach *	Inundation by Local Rainfall **	Remarks
1. Damage Ratio by Inundation Level			
a. Less than 0.5 m	0.50	0.21	MOCJ ***
b. 0.5 to 0.99 m	0.71	0.24	MOCJ
c. 1.0 m or more	0.74	0.37	MOCJ
2. Rice Production Value			
a. Per Hectare	US$ 136		AFDS ****
b. Per Mesh	US$ 544		a x 4 ha

* Damage ratios for inundation lasting 7 days or more
** Damage ratios for inundation lasting 1 to 2 days
*** Ministry of Construction, Japan
**** Asset and Flood Damage Survey

Result

Table F3-12 presents the direct damage values by inundation for 2-year, 5-year, 10-year and 30-year rainfall return period for with- and without-project condition. Economic benefit of inundation mitigation can be derived as the difference between the damage values in without-project and with-project condition.

Table F3-13 shows the conversion of economic benefits for selected rainfall return period to annual average benefits for the proposed Component 2 to Component 7. Indirect benefits are added to direct benefits at 30% of direct benefits. Table F3-14 gives average annual benefits for rice.

The following table summarizes the average annual benefit by component:

Estimated Economic Benefit of Master Plan

(Unit $ thousand / year)

Component	Economic Benefit		
	Direct & Indirect	Rice Production	Total
1	50	0	50
2	6,468	38	6,506
3	10,856	7	10,863
4	9,933	0	9,933
5	2,050	0	2,050
6	731	3	734
7	196	1	197
8	Environmental improvement		

Economic benefits are assumed to grow at a rate of 7.2 % per year, the GRDP growth rate set in Socioeconomic Framework, until 2010, the year in which a full scale benefit of each component is realized.

3.1.2 Economic Cost

Investment cost and operation and maintenance costs estimated are to be modified, where necessary, in economic analysis such that the costs reflect utilization of resources. The following aspects are analyzed.

- Transfer payments such as tax and subsidy;
- Cost of commodities domestically procured;
- Labor wage for unskilled labor; and
- Land cost.

The costs estimated do not include transfer payments such as tax and subsidy. No modification, therefore, is needed in this respect.

Costs of commodities domestically procured are converted to international prices by applying a standard conversion factor (SCF). SCF in Cambodia is estimated at 0.84 in 1996 and 0.85 in 1997 as shown in Table F3-15. Table F3-16 presents shadow prices and standard conversion factors applied in the previous studies. The present study applies 0.85 as SFC. The domestic currency portion of the investment and operation and maintenance costs is converted to international prices by multiplying them with 0.85.

It is often practiced that wages of unskilled labor are adjusted such that labor cost reflects production foregone of the labors. In the present analysis, unskilled labor costs constitute a negligibly small portion of the total cost. SCF at 0.85 is applied to labor costs.

An environmental impact assessment (EIA) was carried out in early 1999 for the two priority projects. The EIA revealed that most of the lands to be affected by the projects are either idle land, water body, or residential land. Almost no production activities seem to be practiced in the priority project area. Assuming that the condition is common for other areas planned in the master plan, no production foregone will result from the implementation of the master plan. The land acquisition costs estimated are included in the costs for economic evaluation applying a SCF of 0.85, judging them as reflecting costs for residents needed to resettle in other areas.

The economic costs thus estimated are shown with operation and maintenance costs and economic benefits in Table F3-17.

3.1.3 Economic Analysis

An economic evaluation of the proposed master plan and each component is carried out with the following principles:

(a) Benefit-cost ratio (B/C), net present value (NPV or B-C) and economic internal rate of return (EIRR) are derived for assessing the economic viability of Master Plan;

(b) The threshold EIRR, or opportunity cost of capital, is assumed at 10%, following the general practice in Cambodia; and

(c) An evaluation period is 50 years.

Table F3-17 shows flows of the costs and benefits for the Master Plan as a whole. Flows of costs and benefits are estimated following the implementation schedule of the Master Plan. The following results are obtained:

- EIRR : 12.9 %
- B/C ratio : 1.25
- Net present value (NPV) : 32,120 thousand US$

It is clarified that the master plan as a whole shows sufficiently high economic return, compared with the opportunity cost of capital at 10 %.

Table F3-18 shows the results of economic evaluation for each component of the master plan. For the purpose of comparison, construction of all the components is assumed to start in 2000. The following table summarizes the result:

Results of Economic Evaluation for Each Component of Master Plan

Component	EIRR (%)	B/C	NPV (US$ 10^3)
1	-0.5	0.18	-1,793
2	24.8	2.92	32,601
3	11.0	1.10	6,413
4	9.1	0.91	-5,880
5	5.3	0.57	-12,010
6	4.8	0.51	-5,544
7	-2.1	0.14	-9,878
8	N/A	N/A	N/A

Among the eight components, Component 2, Reinforcement of Kop Srov Dike, and Component 3, Tompun Watershed Drainage Improvement, show higher economic return. Their EIRRs are 24.8 % and 11.0 % respectively, higher than the opportunity cost of capital at 10 %.

3.2 Financial Analysis of Master Plan

3.2.1 Methodology

A financial analysis of the master plan is carried out from the viewpoint of cost recovery. An analysis is made in the following steps:

- Estimate of present expenditure levels of Department of Public Works and Transport (DPWT) and Drainage and Sewerage Division (DSD) of DPWT;
- Projection of DPWT and DSD's revenue in 2010 * and 2020 **;
- Comparison of the projected revenue level of DSD and the estimated costs for implementing the master plan; and
- Analysis on additional revenue generating measures.

* Target year of the present study
** Final year of the proposed investment

3.2.2 Present Expenditure Levels of DPWT and DSD

Expenditures of Ministry of Public Works and Transport (MPWT), Municipality of Phnom Penh (MPP), Department of Public Works and Transport (DPWT) and Drainage and Sewerage Division (DSD) of DPWT are shown below for 1995, 1996 and 1997. Table F3-19 shows a detail for DPWT and DSD:

Expenditure of MPWT, MPP, DPWT and DSD

(Unit: Riel million)

Organization	1995	1996	1997
MPWT (Ministry of Public Works and Transport)	8,011	7,158	8,340
MPP (Municipality of Phnom Penh)	17,505	22,185	19,651
DPWT (Department of Public Works and Transport)	1,503	994	2,065
DSD (Drainage and Sewerage Division, DPWT)	313	330	383

The expenditures of DPWT and DSD do not include those for power payment. DPWT has been billed for power use for pumping and other facilities, but has not made payments due to lack of fund. The billed amount is about Riel 700 million per year for pumping facilities and Riel 400 to 500 million per year for other facilities. These combined account for from 52 % to 58 % of the DPWT's total expenditure in 1997. DPWT and MPP made a proposal to Electricité du Cambodge (EdC) to collect additional money from power users by imposing a surcharge at 3 % of power tariff as a way to compensate for the shortfall of DPWT's budget for power bill. The proposal has not been agreed by EdC.

From June 1997 to August 1998, MPP received Riel 1,576 million (US$0.41 million) from PPWSA, out of which Riel 1,326 million corresponds to the fund to be transferred during this period from PPWSA to MPP as the revenue generated by the wastewater surcharge at 10 % of water sale. The difference at Riel 250 million is counted as advance payment of the surcharge revenue and will be subtracted from future transfer. Out of this, about Riel 1,000 million (Riel 600 million in 1997 and Riel 400 million in 1998) or 63 % of Riel 1,576 million, was transferred to DPWT. This revenue has been used for various purposes, not limited to operation and maintenance of the sewerage and drainage facilities.

3.2.3 DPWT and DSD's Revenue Levels Projected for 2010

Tables F3-20 and F3-21 present a preliminary estimate of revenues for the central government, DPWT and DSD for 2010 and 2020. The estimate is made based on the following assumptions:

(a) Two cases are estimated as standard and low growth scenarios.

(b) Revenue of the central government is estimated for the year 2006, which is the last year of the World Bank's projection of a number of macroeconomic indicators, 2010, the target year of the present study and 2020 in which the last part of the proposed investment for the master plan is completed. Then the revenues of DPWT and DSD are estimated for 2010 and 2020, applying the growth rates estimated for the central government revenue until 2010 and 2020 for the two scenarios. The underlying idea is that a number of measures being currently implemented to strengthen and expand the taxation system will result in a rise of central government revenue and DPWT will proportionately enjoy an increase in budgetary allocation.

(c) GDP growth rates between 1997 and 2010 are set based on the established Socioeconomic Framework for the standard scenario. The rate for the low growth scenario is 3.6 % per year, half the standard scenario. GDP growth rates between 2010 and 2020 are set lower than the 1997-2010 period: 5.0 % per year and 2.0 % per year for the two scenarios. The growth rate between 1996 and 1997 is 2.0 % based on the actual performance.

(d) The proportion of the central government revenue to GDP is taken from the World Bank's projection. The target in 2006 is 16.9 %, whereas the proportion in 1996 was 9.1 %. This target is assumed to be maintained until 2010 for the standard scenario. The target for the low growth scenario is set at 9.1 % for 2010, assuming no increase in the proportion. The target for 2020 is set at 20 %, and 12 % for the standard scenario and low scenario respectively, considering the prevalent proportions in the neighboring Asian countries as shown in the table below:

Proportion of Government Revenue to GDP
in 1995 in Selected Asian Countries

(Unit: %)

Country	Tax Revenue	Other Revenue	Total
Nepal	9.1	4.3	13.4
Mongolia	20.3	5.0	25.3
Indonesia	16.4	6.2	22.6
Philippine	16.0	4.9	20.9
Thailand	17.1	7.4	24.5
Malaysia	20.6	6.6	27.2
Singapore	17.2	4.6	21.8
Japan	17.6	3.0	20.6

Source: World Development Report 1997, the World Bank

(e) The starting revenue levels of DPWT and DSD for projection are the averages of the revenues from 1995 to 1997 to minimize the impact of annual fluctuation of expenditure levels.

The following levels of revenue are estimated for DPWT and DSD for 2010 and 2020:

Estimated Revenues of DPWT and DSD in 2010 and 2020
Based on Increased Budget Allocation

(Unit : $ million)

Item	Scenario	
	Standard	Low
DPWT		
1997	0.39	0.39
2010	1.75	0.63
2020	3.38	1.01
DSD		
1997	0.09	0.09
2010	0.39	0.14
2020	0.76	0.23

Note : $: Riel 3,880 as mid-point level in October 1998

3.2.4 Comparison with Fund Requirement of Master Plan

Investment cost, depreciation cost and operation and maintenance costs for implementing the proposed master plan are estimated by local and foreign currency portion and by period as follows:

Investment Cost and Operation and Maintenance Costs
of the Master Plan

(Unit: $ million)

Item	By 2010	By 2020
Investment Cost		
Total	154.20	261.10
Local currency portion	61.60	95.50
Foreign currency portion	92.60	165.60
Depreciation *		
Total	3.08	5.22
Local currency portion	1.23	1.91
Foreign currency portion	1.85	3.31
Operation and Maintenance Cost	0.77	1.31

* Depreciation period of 50 years, 100% of investment cost to be depreciated, straight line method applied.

The DSD's revenue and the master plan's fund requirement thus estimated are compared as follows:

Comparison of DSD's Revenue by Increased Budget Allocation
andMaster Plan's Fund Requirement

(Unit: $ million)

Item	2010	2020
Revenue		
Standard Scenario	0.39	0.76
Low Growth Scenario	0.14	0.23
Fund Requirement		
Depreciation (total cost)	3.08	5.22
Depreciation (only local currency portion)	1.23	1.91
Operation and Maintenance Costs	0.77	1.31

In 2010 the estimated revenue of DSD range from $ 0.14 million per year (low growth scenario) to $ 0.39 million per year (standard scenario). The cost of the master plan far exceed these revenue levels. Even operation and maintenance costs cannot be covered by increased budgetary revenue for DSD, let alone depreciation cost for the local currency portion. The same situation is foreseen for 2020. New sources of revenue in addition to the expected rise in the government budget allocation to DPWT need to be sought.

3.2.5 Revenue Enhancement Measures for DPWT and DSD

The existing wastewater charge system is an important tool for DPWT and DSD to generate revenues. Based on the system, PPWSA collected and transferred Riel 1,576 million to MPP during June 1997 to August 1998 period. DPWT received about 63 % or about Riel 1,000 million out of this. A projection by the World Bank estimates the PPWSA's revenue from water sale at Riel 53,091 million in 2007 in 1996 price level as shown in Table F3-22. Applying the rate of 10 % of water tariff, the currently applied rate, a revenue of Riel 5,309 million or $ 1.38 million per year will be generated in 2007. The projection by the World Bank is extrapolated to the years of 2010 and 2020, applying an annual growth rate at 3.2 % per year, the population growth rate set in the Socioeconomic Framework, assuming that the PPWSA's revenue will keep rising in proportion to the assumed population growth. The projected revenue for PPWSA and wastewater surcharge revenue at 10 % of water sale are estimated as follows:

Water revenue

- 2010 : 58.4 billion Riel ($ 15.1 million *)
- 2020 : 80.0 billion Riel ($ 20.6 million *)

Wastewater surcharge revenue (10% of water revenue)

- 2010 : $ 1.51 million
- 2020 : $ 2.06 million

* $1 = Riel 3,880 as the midpoint average in October 1998 applied

The revenue from the wastewater surcharge is added to the budget revenue and compared with the fund requirement as follows:

Comparison of Revenue from Budget Revenue and
Wastewater Surcharge and Master Plan's Fund Requirement

(Unit: $ million)

Item	2010	2020
Revenue		
Budget (standard scenario)	0.39	0.76
Wastewater Surcharge (10% of water sale)	1.51	2.06
Total	1.90	2.82
Fund Requirement		
Total Investment cost Depreciated	3.08	5.22
Local Currency Portion Depreciated	1.23	1.91
Operation and Maintenance Costs	0.77	1.31

The table above shows that the total revenue is larger by more than two times than the operation and maintenance cost of the master plan both in 2010 and 2020. The total revenue will come short of the fund requirement if the depreciation cost of the local currency portion is included in the fund requirement. In the event that foreign assistance be provided only for the foreign currency portion, the local currency portion of the master plan should be financed domestically. This matter is uncertain at this point. Supposing the need for domestic financing of the local currency portion, additional revenue sources become necessary to generate sufficient revenue for covering both operation and maintenance costs and depreciation costs of the local currency portion for the master plan implementation. At this point, it could be concluded that the projected revenue level including that from wastewater surcharge will be able to cover the minimum cost recovery target, that is to recover operation and maintenance costs, on the premise that investment cost be provided by the central government budget.

Theoretically speaking, wastewater surcharge is an appropriate measure for sewerage component, but not for rain water drainage component. The amount of wastewater is determined by the amount of water people use, but the amount of rainfall is determined by natural factors. The wastewater surcharge charged according to the amount of water supplied, therefore, is suited to sewerage component. The basis for applying the wastewater surcharge system to the sewerage and drainage component as currently practiced lie in the following two points:

- The sewerage and drainage system in Phnom Penh is a combined system. It is difficult to clearly divide sewerage and rain water drainage portions.
- Wastewater surcharge is realistically an efficient tool for generating fund.

In a medium- to long-run, introduction of land and property tax should be considered. At present, no tax is imposed as land and property tax in Cambodia. The World Bank Report ("Cambodia, Progress in Recovery and Reform", June 2 1997) points to the necessity of introducing land and property tax over the medium term. Land and property tax is a means for municipal governments to generate fund for providing various urban services. For such services as water supply, sewerage, power, telecommunications and gas, revenue can be generated by tariff in proportion to the amount of services provided from beneficiaries who can be clearly defined, those who are connected to water pipes, sewerage pipes, power lines, telephone lines and gas pipes. For other types of services such as urban drainage, road and various social services, on the contrary, land and property tax is an

appropriate measure for recovering cost. For these types of services, it is impossible to clearly define beneficiaries and measure the amount of services received. For the present project, it would be desirable that the revenue expected from wastewater surcharge be gradually shifted to that by land and property tax in accordance with the reinforcement of the taxation system of the central and local governments.

F.4 Economic and Financial Analyses of Priority Projects

4.1 Economic Analysis of Priority Projects

Economic benefits estimated for each master plan components are applied to the priority projects as follows. They include both direct and indirect benefits.

- Component 2: US$ 6,506 thousand per year in 2010 and thereafter
- Component 3: US$ 6,518 per year in 2010 and thereafter

Economic benefits are assumed to growth at a rate of 7.2 % per year, the GRDP growth rate set in Socioeconomic Framework, until 2010, the year in which a full scale benefit of each component is reached.

Costs for economic analysis are estimated in the same way as for the Master Plan. Local currency portion of the investment cost is adjusted by a standard conversion factor at 0.85. The investment costs are allocated to each year according to the prepared disbursement schedule.

Table F4-1 shows streams of costs and benefits thus estimated. The following economic indices are derived:

Economic Indices for Priority Projects

Indices	Component 2	Component 3	Component 2 plus 3
EIRR (%)	25.2	11.7	16.7
B/C	2.76	1.17	1.69
NPV (US$ thousand)	29,475	5,909	35,384

NPV : net present value

Both components are judged to have sufficiently high economic return with EIRRs higher than the opportunity cost of capital at 10 %. These components are proved to be worth being promoted to the implementation stage.

4.2 Financial Analysis of Priority Projects

A financial analysis for the priority projects is carried out from the viewpoint of cost recovery for Drainage and Sewerage Division (DSD) of Department of Public Works and Transport in the same way as for the Master Plan. Table F4-2 presents a comparison of DSD's expected revenue in 2008, in which the facilities start to serve and operation and maintenance cost needed for the priority projects. The expected revenue includes government budget allocation and revenue by wastewater surcharge estimated based on the same assumptions as for the Master Plan. The cost recovery target is set at the recovery of operation and maintenance cost on the premise that the investment cost be provided by government budget. The following summarizes the result:

Comparison of DSD's Revenue and O/M Cost of Priority Projects

Item	Amount (US$ million)
Revenue by Government Budget in 2008	0.34
Wastewater Surcharge Revenue in 2008	1.41
Total Revenue in 2008	1.76
Total O/M Cost Required since 2008	0.32
Balance	1.40

As of 2008 when the facilities start operation, the DSD's revenue from government budget reaches the level slightly above the operation and maintenance cost. The priority projects are financially feasible from O/M cost recovery viewpoint. This aspect, however, should be closely monitored, paying due attention to the government effort and achievement in enhancing the government revenue and a progress in proportionately increasing allocation to line agencies and local governments.

Table F2-1 Social and Economic Characteristics of Cambodia

Indicators	Unit	Cambodia	Laos	Vietnam	Thailand
a. Total population	million	10.0	4.9	73.5	58.2
b. GNP per capita	1995 US$	270	350	240	2,740
c. GDP in 1995	million US$	2,771	1,760	20,351	167,056
d. GDP composition in 1995					
Agriculture	%	51	52	28	11
Industry	%	14	18	30	40
(Manufacturing)	%	6	4	22	29
Service	%	34	30	42	49
e. GDP growth rate, 1990-1995	%/year	6.4	6.5	8.3	8.4
f. Illiterate population	%	35	43	6	6
g. Rate of population increase	1980-90, %/year	2.9	2.7	2.1	1.7
	1990-95, %/year	2.8	3.0	2.1	0.9
h. Infant mortality rate	per 1,000 births in 1995	108	90	41	35
I. Children going to primary school (1993)					
boy	%	48	123	111*	98
girl	%	46	92	106*	97

Source : World Development Report 1997, the World Bank

Note :

* Figures in 1980

** The figures in this table might not be consistent with those to appear in the tables to follow. In this table, the values in the source document are presented for the purpose of comparison with the other three countries.

Table F2-2 Gross Domestic Product (GDP) of Cambodia

Item	Unit	1991	1992	1993	1994	1995	1996	1997
GDP	10^9 Riel, current prices	1,336	2,509	5,414	6,131	7,200	8,200	9,132
	10^6 US$, current prices	1,634	1,506	1,923	2,385	2,923	3,113	3,177
GDP composition								
Agriculture	%	51.5	46.4	45.8	43.0	43.7	42.6	44.0
Industry	%	11.6	13.0	15.0	16.3	16.3	17.8	17.3
Services	%	36.9	40.6	39.2	40.7	40.0	39.6	38.7
Annual growth rates	(at 1989 prices)							
Agriculture	%/year	2.9	0.3	4.1	0.5	6.4	2.4	5.2
Industry	%/year	11.6	22.3	19.4	15.3	9.5	15.0	0.6
Services	%/year	12.2	9.6	7.3	11.9	8.2	7.3	-0.4
GDP	%/year	7.6	7.1	4.1	4.0	7.6	6.5	2.0
GDP by sector *								
Agriculture	10^9 Riel, current prices	688	1,164	2,480	2,636	3,146	3,493	4,018
Industry	10^9 Riel, current prices	155	326	812	999	1,174	1,460	1,580
Services	10^9 Riel, current prices	493	1,019	2,122	2,495	2,880	3,247	3,534

Source : Public Investment Programme 1998 - 2000, PIP Unit, Department of Investment, Ministry of Planning

Note :

(1) Average annual growth rates between 1990 and 1997
- Agriculture 3.1 %/year
- Industry 13.2 %/year
- Services 7.9 %/year
- GDP 5.5 %/year

(2) GDP growth rate in 1990 was 1.2% per year.

(3) GDP per capita in 1996 :
- Population : 10,340 thousand (Table 2.2.3)
- GDP : 3,113 million US$
- GDP per capita : 301 US$

* Calculated based on GDP values and compositions.

Table F2-3 Socioeconomic Profile of Phnom Penh City (1/2)

Socio-economic Indicators	Data source	Phnom Penh		Cambodia		Share of Phnom Penh (%)
1 Land area & density						
a. Land area (km^2)	(1)	290.06		181,035		0.2
b. Population density in 1996 (person/km^2)	a,d	2,748		57		-
2 Population						
c. Population in 1986 (thousand)	(1),(6)	581		7,672		7.6
d. Population in 1996 (thousand)	(2)	797		10,340		7.7
e. Annual growth rates between 1986 and 1996 (%/year)	c,d	3.2		3.0		-
f. Population in March 1998	(5)	872,185		n.a.		-
g. Sex composition in 1996	(2)					
Male		47%		48%		-
Female		53%		52%		-
h. Number of household (1996)	(2),(5)	150,286 *		1,961,841		7.7
I. Average household size (1996)	d,h	0.01 *		0.01		-
j. Age structure (%)	(2)					
0-19		47.5		53.6		-
20-39		30.6		27.2		-
40-59		16.8		13.6		-
60-		5.1		5.5		-
3 Migration (1996)						
k. Population living at the present place since birth	(2)	251,688		8,158,902		3.1
l. Population migrated from outside present province	(2)	339,770		1,063,855		31.9
m. % of migration population	d,l	43%		10%		-
n. Number of temporary migrants	(2)	25,163		61,414		41.0
o. % of temporary migrants to population	d,n	3.2%		0.6%		-
4 Labor Force (1996)						
p. Population of 10 years and over	(2)	620,540		7,496,564		8.3
q. Those in labor force	(2)	342,002		4,904,294		7.0
r. Those employed	(2)	319,699		4,858,769		6.6
s. Those unemployed	(2)	22,303		45,525		49.0
t. Unemployment rate (%)	q,s	6.5		0.9		-
u. Composition of labor force	(2)					
Agriculture, forestry, fishery, livestock		40,271	13%	3,797,283	78%	1.1
Mining/quarrying, manufacturing, construction, water/gas		42,781	14%	230,143	5%	18.6
Services		233,029	74%	831,595	17%	28.0
Total		316,081	100%	4,859,021	100%	6.5
5 Agriculture production						
v. Cultivateda area of rice (thousand ha) :	(1)					
1980		3		1,441		0.2
1985		3		1,462		0.2
1990		13		1,890		0.7
1995		10		2,086		0.5
w. Cultivateda area of corn (thousand ha) :	(1)					
1980		0.2		102		0.2
1985		0.2		51		0.4
1990		0.2		47		0.4
1995		0.5		52		1.0

* in 1998

Table F2-3 Socioeconomic Profile of Phnom Penh City (2/2)

Socio-economic Indicators	Data source	Phnom Penh		Cambodia		Share of Phnom Penh (%)
6 Household Income/expenditure (Oct. 1993-Sept. 1994)						
x. Average Monthly expenditure per household (Riel/household/month)	(3)	781,201		290,556		268.9
y. Expenditure distribution	(3)					
1. (Lowest 20%)		5.3		7.4		-
2.		9.7		11.4		-
3.		14.4		14.9		-
4.		21.0		20.2		-
1. (Highest 20%)		49.6		46.1		-
Total		100.0		100.0		-
z. Average Monthly expenditure per household by expenditure strata (Riel/household/month)	(3)					
1. (lowest 10%)		160,249		90,509		177.1
2.		252,754		126,321		200.1
3.		335,509		152,582		219.9
4.		420,623		176,020		239.0
5.		512,014		201,728		253.8
6.		612,438		231,650		264.4
7.		731,612		270,170		270.8
8.		905,900		317,920		284.9
9.		1,221,103		403,189		302.9
10. (highest 10%)		2,652,786		934,995		283.7
aa. Source of income	(3)					
Monetary income		338,369	64%	114,142	67%	296.4
Non-monetary income		191,174	36%	55,128	33%	346.8
Agriculture products		2,968		19,338		15.3
Forestry products		0		0		-
Others		0		0		-
Net rental value of owner-occupied house		141,951		21,572		658.0
Income in kind		4,209		1,219		345.3
Non-agriculture activities		48,046		13,000		369.6
Total		529,543		169,270		312.8
7 Industrial sector (1993)						
ab. Industrial sector	(4)					
Number of establishment		129		578		22.3
Number of workers		4,733		24,522		19.3
Value added (million Riel)		33,801		106,057		31.9
ac. Manufacturing sector	(4)					
Number of establishment		123		543		22.7
Number of workers		4,122		22,991		17.9
Value added (million Riel)		18,013		89,295		20.2

Sources :

(1) Statistics Book 1995, National Institute of Statistics
(2) Socio Economic Survey of Cambodia 1996, Volume II Summary Results, National Institute of Statistics June 1997
(3) Socio Economic Survey of Cambodia 1993/94 (all rounds), National Institute of Statistics
(4) Survey of Indistrial Establishments 1993, National Institute of Statistics
(5) Deparment of Planning, Municipality of Phnom Penh
(6) Economic and Cultural Condition of Phnom Penh during 18 years between 1979 and 1996, Phnom Penh Municipality

Table F2-4 Estimated GRDP of Phnom Penh

Item	Unit	Sector			
		Agriculture	Industry	Service	Total
Cambodia					
GDP in 1996	10^9 Riel, current prices	3,493	1,460	3,247	8,200
Number of workforce in 1996	number	3,797,283	230,143	831,595	4,859,021
GDP per worker	Riel, current prices	919,868	6,343,882	3,904,545	1,687,583
Phnom Penh					
Number of workforce in 1996	number	40,271	42,781	233,029	316,081
GRDP per worker	Riel, current prices	919,868	6,343,882	3,904,545	1,687,583
GRDP	10^9 Riel, current prices	37	271	910	1,218
		3%	22%	75%	100%
GRDP/GDP	%	1.1	18.6	28.0	14.9

Note :

(1) GDP : Gross Domestic Product

(2) GRDP : Gross Regional Domestic Product

(3) Phnon Penh's GRDP is estimated assuming the same GRDPs per worker as GDPs per worker in Cambodia.

(4) Definition of sectors

Agriculturey : agriculture, forestry, fishing, livestock

Industry : mining and quarrying, manufacturing, power/gas/water and construction

Service : various services

Source :

(1) Number of workers : Socio Economic Survey of Cambodia 1996, National Institute of Statistics

(2) GDP : Table 2.2.2

Estimate of GRDP per capita in US$

a. Population in Phnom Penh 797 thousand in 1996

b. Exchange rate in December 1996 2,720 Riel / US$

c. GRDP in US$: US$ 448 million (1,218 billion Riel / 2,720 Riel / US$)

d. GRDP per capita of Phnom Penh : US$ 562 per capita in 1996

Estimate of annual growth rate of Phnom Penh's GRDP

Cambodia's GDP growth rates and weight for sectors

	GDP growth rate		Weight		
Agriculture	3.1 %/year	*	0.03	=	0.093
Industry	13.2 %/year	*	0.22	=	2.904
Services	7.9 %/year	*	0.75	=	5.925
			Total	=	8.922

GRDP growth of Phnom Penh (1990-97) = 8.9%/year

Table F2-5 Population of Study Area

District/sub-district	Total area in km²	Area in %		Area in km²		Population		
		in SA *	outside SA	in SA	outside SA	Total	in SA	outside SA
(Three suburban districts lying across study area boundary)								
Dang Kor								
1 Cheung Ek	11.6	0	100	0.0	11.6	5,081	0	5,081
2 Dang Kor	16.8	16	84	2.7	14.1	9,426	1,508	7,918
3 Prey Sar	10.6	53	47	5.6	5.0	4,037	2,140	1,897
4 Prey Veng	7.8	47	53	3.7	4.1	2,865	1,347	1,518
5 Sak Sampouv	6.3	0	100	0.0	6.3	1,951	0	1,951
6 Pong Toek	9.7	84	16	8.1	1.6	5,693	4,782	911
7 Kraing Prongor	8.6	0	100	0.0	8.6	2,288	0	2,288
8 Prateas Lang	8.6	0	100	0.0	8.6	3,789	0	3,789
9 Pleung Chhes Rotes	10.5	6	94	0.6	9.9	3,803	228	3,575
10 Chom Chao	28.0	100	0	28.0	0.0	15,673	15,673	0
11 Trapaing Krasaing	9.3	12	88	1.1	8.2	2,600	312	2,288
12 Samrong Krom	21.0	49	51	10.3	10.7	4,026	1,973	2,053
13 Kok Kokar	28.8	56	44	16.1	12.7	5,306	2,971	2,335
14 Kraing Thnong	9.4	100	0	9.4	0.0	2,773	2,773	0
15 Kakab	13.1	100	0	13.1	0.0	14,405	14,405	0
sub-total	*200.1*	*49*	*51*	*98.8*	*101.3*	*83,716*	*48,112*	*35,604*
Mean Chey								
1 Chbar Ampouv 1	0.513	0	100	0.0	0.5	10,304	0	10,304
2 Chbar Ampouv 2	1.938	0	100	0.0	1.9	24,000	0	24,000
3 Nirod	6.075	0	100	0.0	6.1	13,952	0	13,952
4 Prek Pra	5.313	0	100	0.0	5.3	11,161	0	11,161
5 Chak Angre Leu	2.250	0	100	0.0	2.3	16,033	0	16,033
6 Chak Angre Krom	8.463	0	100	0.0	8.5	19,775	0	19,775
7 Beung Toum Poun	4.125	100	0	4.1	0.0	28,930	28,930	0
8 Strung Meanchey	9.575	100	0	9.6	0.0	31,557	31,557	0
sub-total	38.252	*36*	*64*	*13.7*	*24.6*	*155,712*	*60,487*	*95,225*
Russey Keo								
1 Suay Pak	6.238	100	0	6.2	0.0	10,243	10,243	0
2 Chrang Chamres 1	3.163	100	0	3.2	0.0	7,898	7,898	0
3 Chrang Chamres 2	3.363	100	0	3.4	0.0	11,386	11,386	0
4 KM No 6	4.250	100	0	4.3	0.0	12,527	12,527	0
5 Russey Keo	3.563	100	0	3.6	0.0	17,666	17,666	0
6 Toul Sangke	3.713	100	0	3.7	0.0	22,020	22,020	0
7 Chroy Chang Var	8.375	0	100	0.0	8.4	13,744	0	13,744
8 Prek Leap	9.013	0	100	0.0	9.0	9,462	0	9,462
9 Prek Tasek	16.338	0	100	0.0	16.3	4,923	0	4,923
10 Toek Tla	5.825	100	0	5.8	0.0	26,143	26,143	0
11 Phnom Penh Thmey	17.113	100	0	17.1	0.0	17,866	17,866	0
12 Khmounh	13.388	100	0	13.4	0.0	5,890	5,890	0
sub-total	*94.342*	*64*	*36*	*60.6*	*33.7*	*159,768*	*131,639*	*28,129*
Total of three districts	*332.7*	*0.52*	*0.48*	*173.1*	*159.6*	*399,196*	*240,238*	*158,958*
							60.2%	*39.8%*
(Four downtown districts)								
Chamkarmon	9.8	100	0	9.8	0	148,432	148,432	0
Don Penh	6.2	100	0	6.2	0	110,727	110,727	0
Prampi Makara	2.3	100	0	2.3	0	92,463	92,463	0
Toul Kork	7.9	100	0	7.9	0	130,139	130,139	0
Total of four districts	*26.2*	*100*	*0*	*26.2*	*0*	*481,761*	*481,761*	*0*
GRAND TOTAL	**358.9**	**55.5**	**44.5**	**199.3**	**159.6**	**880,957**	**721,999**	**158,958**
							82.0%	**18.0%**

Note :

(1) * SA = Study Area

(2) Population figures for outlying three districts are based on the data provided by each district office. Those of downtown four districts are obtained at the Department of Planning of the Municipality of Phnom Penh.

(3) Areas of each district and sub-districts are measured by the JICA study team.

(4) The total area of the Study Area derived as sum of all the sub-districts and districts at 199.3 km² is slightly greater than the total area derived for land use analysis at 196.58 km². A deviation of this magnitude is judged negligible, especially because the objective of the analysis here is to derive a proportion of population living within the study area.

(5) The areas above include both land area and water surface.

Table F2-6 Population in Northeast, Northwest and Middle Areas Protected by Kop Srov and Tompun Dikes

District/sub-district	Population in SA	Population in Comp. 2 Area	
		Proportion (%)	Population
Dang Kor			
1 Cheung Ek	0	0	0
2 Dang Kor	1,508	0	0
3 Prey Sar	2,140	0	0
4 Prey Veng	1,347	0	0
5 Sak Sampouv	0	0	0
6 Pong Toek	4,782	0	0
7 Kraing Prongor	0	0	0
8 Prateas Lang	0	0	0
9 Pleung Chhes Rotes	228	0	0
10 Chom Chao	15,673	25	3,918
11 Trapaing Krasaing	312	0	0
12 Samrong Krom	1,973	100	1,973
13 Kok Kokar	2,971	100	2,971
14 Kraing Thnong	2,773	100	2,773
15 Kakab	14,405	100	14,405
sub-total	*48,112*		26,040
Mean Chey			
1 Chbar Ampouv 1	0	0	0
2 Chbar Ampouv 2	0	0	0
3 Nirod	0	0	0
4 Prek Pra	0	0	0
5 Chak Angre Leu	0	0	0
6 Chak Angre Krom	0	0	0
7 Beung Toum Poun	28,930	100	28,930
8 Strung Meanchey	31,557	25	7,889
sub-total	*60,487*		36,819
Russey Keo			
1 Suay Pak	10,243	20	2,049
2 Chrang Chamres 1	7,898	100	7,898
3 Chrang Chamres 2	11,386	100	11,386
4 KM No 6	12,527	100	12,527
5 Russey Keo	17,666	100	17,666
6 Toul Sangke	22,020	100	22,020
7 Chroy Chang Var	0	0	0
8 Prek Leap	0	0	0
9 Prek Tasek	0	0	0
10 Toek Tla	26,143	100	26,143
11 Phnom Penh Thmey	17,866	100	17,866
12 Khmoumh	5,890	100	5,890
sub-total	*131,639*		123,445
Registered population			186,304
Non-registered population			40,987
Total population			**227,291**

Note :
Proportion of non-registered population to registered population : 22%

Table F2-7 Population in Tompun Watershed

District/subdistrict		Population by sub-district	Population in Component 3 Area	
			Proportion (%)	Population
Chamkarmon				
1	Tonle Basac	33,561	0	0
2	Beung Keng Kang 1	10,403	0	0
3	Beung Keng Kang 2	10,161	0	0
4	Beung Keng Kang 3	17,641	0	0
5	Phsar Olimpic	7,911	0	0
6	Phsar Svay Prey 1	10,304	0	0
7	Phsar Svay Prey 2	10,217	100	10,217
8	Beung Trabek	7,926	0	0
9	Phsar Deum Tkov	13,552	0	0
10	Toul Toum Poung 1	8,564	0	0
11	Toul Toum Poung 2	7,727	0	0
12	Toum Noup Teuk	10,568	100	10,568
	sub-total	148,535		20,785
Don Penh				
1	Sras Chork	26,640	0	0
2	Wat Phnom	8,091	0	0
3	Phsar Chars	8,322	0	0
4	Phsar Kandal 1	10,302	0	0
5	Phsar Kandal 2	7,826	0	0
6	Chey Choumneas	10,027	0	0
7	Chak To Mouk	9,281	0	0
8	Beang Reang	6,402	0	0
9	Phsar Tmey 1	6,780	0	0
10	Phsar Tmey 2	7,054	0	0
11	Phsar Tmey 3	11,107	0	0
	sub-total	111,832	0	0
Prampi Makara				
1	Mitapheap	11,148	100	11,148
2	Nonoroum	12,980	100	12,980
3	Veal Vong	21,250	100	21,250
4	Beung Prolit	11,502	0	0
5	Phsar O Russey 1	9,109	0	0
6	Phsar O Russey 2	10,625	0	0
7	Phsar O Russey 3	8,455	0	0
8	Phsar O Russey 4	9,080	0	0
	sub-total	94,149		45,378
Toul Kork				
1	Beng Kak 1	13,777	0	0
2	Beng Kak 2	20,151	0	0
3	Toeuk Loak 1	11,856	100	11,856
4	Toeuk Loak 2	12,492	100	12,492
5	Toeuk Loak 3	9,464	100	9,464
6	Beung Salang	17,751	100	17,751
7	Phsar Deum Kor	14,468	100	14,468
8	Phsar Deipo 1	9,216	100	9,216
9	Phsar Deipo 2	10,863	100	10,863
10	Phsar Deipo 3	10,102	100	10,102
	sub-total	*130,139*		96,212
Outlying Sub-districts				
	Beung Toum Poun	28,930	100	28,930
	Strung Meanchey	31,557	50	15,779
	Toek Tla	26,143	50	13,072
	Registered population			220,155
	Non-registered population			48,434
	Total population			268,589

Note :

(1) The total population of each district presented above are obtained from district ofices and and slightly different from the total registered population provided by City Hall.

(2) Sub-district population of Toul Kork is derived by applying the ratio in 1992 to the district total population obtained from City Hall due to lack of sub-district data.

(3) Proportion of non-registered population to registered population : 22%

Table F2-8 Socioeconomic Development Targets and Prospects in Cambodia

Item	Unit	Year						
		1996	1997	1998	1999	2000	2001	2002-2006
1. SEDP								
Economy								
a. Real GDP growth	%/year	7.5	7.5	7.5	7.5	7.5	-	-
Agriulture	%/year	5.2	5.2	5.2	5.2	5.2	-	-
Industry	%/year	11.8	9.8	9.8	9.8	9.8	-	-
Service	%/year	8.2	9.0	9.0	9.0	9.0	-	-
b. Consumer price index	%	5.0	5.0	5.0	5.0	5.0	-	-
c. Domestic exports	US$ million	53	59	65	72	80	-	-
d. Retained imports	US$ million	490	510	540	600	700	-	-
e. Budget revenue	% of GDP	9.9	10.4	10.8	11.2	11.6	-	-
f. Budget expenditure	% of GDP	17.0	16.2	16.1	16.4	16.9	-	-
g. Current budget surplus (deficit)	% of GDP	-0.3	0.6	1.1	1.4	1.6	-	-
h. Overall budget deficit	% of GDP	-7.1	-5.8	-5.3	-5.2	-5.3	-	-
Social condition								
I. Infant mortality	No per 1,000 live births	115 *	-	-	-	80	-	-
j. Access to safe water								
Urban	%	65 *	-	-	-	90	-	-
Rural	%	26 *	-	-	-	65	-	-
k. Sanitation								
Access to improved toilet facility								
Urban	%	74 *	-	-	-	100	-	-
Rural	%	6 *	-	-	-	20	-	-
2. WB report								
a. Real GDP growth	%	6.5	6.5	6.5	7.1	7.1	7.1	7.6
b. Inflation	%	9.0	5.0	5.0	5.0	5.0	5.0	5.0
c. Revenue/GDP	% of GDP	9.1	9.7	11.1	13.7	13.7	13.7	16.9
d. Current expenditure/GDP	% of GDP	9.9	9.4	10.5	12.2	12.2	12.2	13.1
3. PIP 1998-2000								
a. Real GDP growth	%	-	-	7.0	7.0	7.0	-	-
b. Planned public investment amount	US$ thousand	-	-	304,325	401,705	493,970	-	-

Note :
(1) SEDP : " First Five Year Socioeconomic Development Plan 1996 - 2000 ", Royal Government of Cambodia, 1997
(2) WP report : " Cambodia, Progress in Recovery and Reform ", World Bank, June 2 1997
(3) PIP 1998-2000 : " Public Investment Programme 1998 - 2000 ", Ministry of Planning
* as of 1994

Table F2-9 Public Investment Programme 1998 - 2000

(Unit : US$ thousand)

Sector/sub-sector	Year			Total	
	1998	1999	2000	Value	(%)
Capital investment projects/programs					
Agriculture	11,110	26,189	34,224	71,523	9.0
Transport	37,822	55,926	136,323	230,071	29.0
Communications	24,259	18,513	22,620	65,392	8.2
Energy	19,795	52,886	43,245	115,926	14.6
Trade and industry	0	1,157	11,780	12,937	1.6
Education	25,261	40,433	47,328	113,022	14.2
Religion and culture	3,990	4,498	178	8,666	1.1
Administration	0	0	0	0	0.0
Water supply and sanitation	33,357	43,292	23,666	100,315	12.6
Health	9,246	7,521	10,788	27,555	3.5
Environment and conservation	0	1,600	3,986	5,586	0.7
Social and community services	5,759	14,589	19,859	40,207	5.1
Tourism	410	917	1,420	2,747	0.3
Sub-total	*171,009*	*267,521*	*355,417*	*793,947*	*100.0*
Technical assistance					
Agriculture	24,442	30,167	32,758	87,367	21.5
Transport	600	500	0	1,100	0.3
Communications	0	0	0	0	0.0
Energy	3,976	2,468	0	6,444	1.6
Trade and industry	2,684	2,163	1,090	5,937	1.5
Education	14,460	16,926	24,149	55,535	13.7
Religion and culture	91	305	385	781	0.2
Administration	8,185	3,810	3,511	15,506	3.8
Water supply and sanitation	292	1,062	0	1,354	0.3
Health	66,064	71,157	74,276	211,497	52.1
Environment and conservation	5,959	2,733	54	8,746	2.2
Social and community services	6,562	2,893	2,330	11,785	2.9
Tourism	0	0	0	0	0.0
Sub-total	*133,315*	*134,184*	*138,553*	*406,052*	*100.0*
Total					
Agriculture	35,552	56,356	66,982	158,890	13.2
Transport	38,422	56,426	136,323	231,171	19.3
Communications	24,259	18,513	22,620	65,392	5.4
Energy	23,771	55,354	43,245	122,370	10.2
Trade and industry	2,684	3,320	12,870	18,874	1.6
Education	39,721	57,359	71,477	168,557	14.0
Religion and culture	4,081	4,803	563	9,447	0.8
Administration	8,185	3,810	3,511	15,506	1.3
Water supply and sanitation	33,649	44,354	23,666	101,669	8.5
Health	75,310	78,678	85,064	239,052	19.9
Environment and conservation	5,959	4,333	4,040	14,332	1.2
Social and community services	12,321	17,482	22,189	51,992	4.3
Tourism	410	917	1,420	2,747	0.2
Sub-total	*304,324*	*401,705*	*493,970*	*1,199,999*	*100.0*

Source : Public Investment Programme 1998 - 2000, Ministry of Planning

Table F3-1 Projected Population of Phnom Penh in 2010

Item	Value	Source
a. Population in 1998*	1,000,000	City Hall
b. Natural growth		
b-1 Natural growth rate	2.4%/year	(1)
b-2 Population with natural growth in 2010	1,329,000	a. and b-1
b-3 Increase by natural growth by 2010	329,000	b-2 minus a.
c. Social growth		
c-1 Labor force in 1996	316,081	progress R.
c-2 Labor force in 1998	337,837	calculated
c-3 Labor force in 2010 required to achieve target economic growth	503,687	calculated
c-4 Required increase in labor force between 1998 and 2010	166,000	c-3 minus c-2
c-5 Number of labor in a household	2.1	316,081/151,936
c-6 Required increase in household by 2010	79,048	c-4/c-5
c-7 Household size	5.7persons per hh	872,185/151,936
c-8 Required increase in population by 2010	451,000	c-6 times c-7
c-9 Required population migration to Phnom Penh by 2010	122,000	c-8 minus b-3
d. Population in 2010		
d-1 Total population in Phnom Penh in 2010	1,451,000	a.plus b-3 plus c-8
d-2 Average annual growth rate between 1998 and 2010	3.2%/year	

Source :
(1) City Hall
(2) The Population of Cambodia, 1980-1996, and Projected to 2020, National Institute of Statistics, May 1997
Note : * Population includes both registered and non-registered population.

Table F3-2 Gross Regional Domestic Product (GRDP) of Phnom Penh Projected for 2010

Sector	1996			Assumed growth rates of GRDP by sector	2010				Rate of change in labor productivity
	Phnom Penh's GRDP in 1996 price	Laborforce	Labor productivity		Phnom Penh's GRDP in 1996 price	Labor force		Labor productivity	
	(10^9 Riel)	(number)	(10^3 Riel/labor)	(%/year)	10^9 Riel	Assumed growth rates (%/year)	(Number)	(10^3 Riel/labor)	(%/year)
Agriculture	37	40,271	919	4.6	69	2.3	55,367	1,246	2.2
Industry	271	42,781	6,335	8.9	894	4.5	78,699	11,360	4.3
Services	910	233,029	3,905	6.7	2,256	3.4	369,621	6,104	3.2
Total	1,218	316,081	3,853	7.2	3,219	3.4	503,687	6,391	3.7

GDP growth targets between 1995 and 2000 in SEDP

Sector	SEDP original growth targets (%/year)	Growth rates adjusted by reflecting actual performance in 1996 and 1997 (%/year)
Agriculture	5.2	4.6
Industry	10.2	8.9
Services	8.8	6.7
GDP	7.5	7.2

Target and actual GDP growth rates in 1996 and 1997

(%/year)

	1996	1997
Agriculture		
target	5.2	5.2
estimate	2.4	5.2
Industry		
target	11.8	9.8
estimate	15.0	0.6
Service		
target	8.2	9.0
estimate	7.3	-0.4

Table F3-3 Densities by Land Use Type

(Unit : number per mesh)

Land use type		Household	Factories	Shops	Offices	Warehouse	School	Hospital
(1998)								
0	Out of study area	-	-	-	-	-	-	-
1	Dense activities	3.2	2.0	2.0	0.2	0.08	0.002	0
2	Dense urban center	500.0	0.5	11.9	2.6	0.80	0.368	0.079
3	Dense residential	160.0	1.0	3.2	0.1	0.02	0.118	0.043
4	Loose residential	16.0	0	0.4	0	0	0.012	0
5	Loose activities	3.2	0	0.9	0	0	0.002	0
6	Agriculture land, unused land	3.0	0	0.1	0	0	0.002	0
7	Green space, park	0.0	0	0	0	0	0	0
8	Fish pond	3.0	0	0	0	0	0	0
9	Lakes, pond, river	0.0	0	0	0	0	0	0
(2010)								
0	Out of study area	-	-	-	-	-	-	-
1	Dense activities	3.5	2.2	2.1	0.3	0.09	0.003	0.000
2	Dense urban center	546.0	0.5	12.5	3.1	0.95	0.400	0.096
3	Dense residential	174.7	1.1	3.4	0.1	0.03	0.128	0.038
4	Loose residential	17.5	0.0	0.5	0.0	0.00	0.013	0.000
5	Loose activities	3.5	0.0	1.0	0.0	0.00	0.003	0.000
6	Agriculture land, unused land	3.3	0.0	0.1	0.0	0.00	0.002	0.000
7	Green space, park	0.0	0.0	0.0	0.0	0.00	0.000	0.000
8	Fish pond	3.3	0.0	0.0	0.0	0.00	0.000	0.000
9	Lakes, pond, river	0.0	0.0	0.0	0.0	0.00	0.000	0.000

Table F3-4 Values of Buildings and Assets of Shops, Factories, Warehouses, Offices, Schools and Hospitals

Item	Unit	Shop	Factory		Ware-house	Office	School	Hospital
			Small	Large				
(Growth rates of Socio-Economic framework)								
Sector	-	Service	Industry	Industry	Service	Service	Social	Social
Growth rates until 2010 (1)	%/year	6.7	8.9	8.9	6.7	6.7	3.2	3.2
Growth rates in building/asset value assumed (2)	%/year	3.4	4.5	4.5	3.4	3.4	0.0	0.0
(Building, 1998)								
Value of building	$/bld.	4,800	9,000	57,600	12,500	10,000	100,000	22,000
Number of building	no.	3,584	354	181	134	438	105	24
Total value ($)	$	17,203,200	3,186,000	10,425,600	1,675,000	4,380,000	10,500,000	528,000
(Building, 2010)								
Value of building	$/bld.	7,169	15,263	97,683	18,671	14,936	100,000	22,000
(rounded down)	$/bld.	7,100	15,200	97,600	18,600	14,900	100,000	22,000
Total value ($)	$	37,461,251	8,862,991	29,002,512	3,647,437	9,537,777	15,323,066	770,531
Number of building	no.	5,225	581	297	195	639	153	35
(Assets, 1998)								
Value of assets	$/bld.	800	11,300	72,600	3,400	8,800	7,800	11,400
Number of building	no.	3,584	354	181	134	438	105	24
Total value	$	2,867,200	4,000,200	13,140,600	455,600	3,854,400	819,000	273,600
(Assets, 2010)								
Value of assets	$/bld.	1,195	19,163	123,121	5,078	13,144	7,800	11,400
(rounded down)	$/bld.	1,100	19,100	123,100	5,000	13,100	7,800	11,400
Total value ($)	$	6,243,542	11,127,978	36,555,250	992,103	8,393,243	1,195,199	399,275
Number of building	no.	5,225	581	297	195	639	153	35

Note :

(1) The growth rates of each sector are set in the Socio-Economic Framework as follows.

	(%/year until 2010)
Industry	8.9
Service	6.7
Social (Population)	3.2

(2) Proportion of rate of increase in value by asset value increase :
(remaining increase by increase in number of buildings/assets)

Shop, factory, ware	50%	of total growth rate
School, hospital :	0%	no growth assumed, all growth due to an increase in number

Table F3-5 Estimate of Coefficient for Adjusting Average Values of House and Household Assets based on Average Income Differential

(1)	Total number of labor force	140,683		
(2)	Total wage paid to workers	15,910	million Riel	
(3)	Average wage per worker	113,089	Riel/labor/month	(2)/(1)
(4)	Number of labor force in 1996	342,002		Source a.
(5)	Number of household in 1996	150,286		Source a.
(6)	Average number of workers in a household	2.3		(4)/(5)
(7)	Average household income in 1996	257,354	Riel/household/month	(1)*(6)
(8)	Price index			
	8.1 1996 (April)	107.33		Source b.
	8.2 1997 (April)	114.12		Source b.
	8.3 Price Index (1998/1996)	1.06		8.2/8.1
(9)	Average household income in 1997	273,635	Riel/household/month	
		72	$/household/month	
		864	$/household/year	
(10)	Exchange rate, US$1 =	3,800	Riel	
(11)	Average household income of households in 1997 surveyed by the AFDS in 1998	1,093	$/year in 1997	
(12)	Coefficient to adjust asset value surveyed by AFDS	0.79		(9)/(11)

Source :

a. Socio Economic Survey of Cambodia 1996, Volume II Summary Results, National Institute of Statistics

b. Consumer Price Index April 1998, National Institute of Statistics

Estimate of Average Wage in 1996

Monthly wage strata (Riel/month)	Mid-point wage by strata (Riel/month)	Number of labor by strata	Total wage by strata (Riel/month)
100 - 49900	25,000	42,470	1,061,750,000
50,000 - 99,900	74,950	47,889	3,589,280,550
100,000 - 149,900	124,950	24,248	3,029,787,600
150,000 - 199,900	174,950	10,000	1,749,500,000
200,000 - 299,900	249,950	8,869	2,216,806,550
300,000 - 499,900	399,950	3,058	1,223,047,100
500,000 - 749,900	624,950	3,100	1,937,345,000
750,000 - 999,900	874,950	754	659,712,300
1,000,000 - 1,999,900	1,499,950	295	442,485,250
2,000,000	2,000,000	0	0
Total		140,683	15,909,714,350

Source : Labor Force Survey of Phnom Penh May 1997, National Institute of Statistics

Table F3-6 Estimate of Values of House and Household Assets

Values of House and Household Assets in 1998 and 2010

(House)	
Surveyed value in 1998	3,807 $/house
Adjustment coefficient	0.79
Adjusted value in 1998	3,008 $/house
Rate of increase until 2010 as a result of per capita income rise	1.6 times
	(3.8 %/year growth)
Value of house in 2010	4,812 $/house
Average number of floors	1.4 stories
Value of house in 2010 to be damaged by inundation	3,437 $/house
(rounded)	3,400 $/house
(Household Asset)	
Surveyed value in 1998	1,126 $/household
Adjustment coefficient	0.79
Adjusted value in 1998	890 $/household
Rate of increase until 2010 as a result of per capita income rise	1.6 times
	(3.8 %/year growth)
Value of house in 2010	1,423 $/household
Average number of floors	1.4 stories
Value of house in 2010 to be damaged by inundation	1,017 $/household
(rounded)	1,000 $/household

Table F3-7 Damage Ratio by 0.5 Meter Depth Range

Type	Level of inundation					
		above floor level				
	below floor	less than 50 cm	50-99 cm	100-199 cm	200-299cm	300 cm -
House building *	0.032	0.092	0.119	0.266	0.580	0.834
Household goods *	0.021	0.145	0.326	0.508	0.928	0.991
Business organizations						
Building and goods*	0.032	0.092	0.119	0.266	0.580	0.834
Inventory	0.056	0.128	0.267	0.586	0.897	0.982
Farmers and fishermen						
Building and goods	0.000	0.156	0.237	0.297	0.651	0.698
Inventory	0.000	0.199	0.370	0.491	0.767	0.831

Source : Ministry of Construction, Japan

Note : Only those damage ratios with * are applied to the present analysis. The other ratios are shown for reference.

Table F3-8 Estimated Inundation Damage Values Compared with Damage Values Surveyed by AFDS (1/7)

1. Household

Total number of households in the Study Area : 143,000
Number of samples surveyed : 416

(Surveyed)

a. Average damage values declared

(Unit : S/case)

Item	1995	1996	Average	(%)
Building	439	256	348	54.0
Assets	161	161	161	25.0
Utilities	18	5	12	1.9
Income lost	88	59	74	11.5
Health	66	31	49	7.6
Average per household	341	143	242	-
Total	-	-	644	100.0

b. Average floor level 0.54 meter
c. Average inundation depth
1995 flood 0.62 meter
1996 flood 0.60 meter

(Estimated)

d. Building
Value $3,008
Damage ratio (less than 0.5 m above floor) 0.092
Estimated damage **$277**
e. Assets
Value $890
Damage ratio (less than 0.5 m above floor) 0.145
Estimated damage **$129**
f. Sub-total (a + b) **$406**

Note :
Damages values in " Estimated " are those estimated by the Study Team based on a number of assumptions, while the values in " (Surveyed) "are those surveyed by Asset and Flood Damage Survey (AFDS) conducted by TEAM Consulting Engineers Co.,Ltd. as part of the present study.

Table F3-8 Estimated Inundation Damage Values Compared with Damage Values Surveyed by AFDS (2/7)

2. Shop

Total number of shops in the Study Area : 3,584
Number of samples surveyed : 121

(Surveyed)

a. Average damage values declared

(Unit : $/case)

Item	1995	1996	Average	(%)
Building	299	127	213	40.9
Assets	95	25	60	11.5
Utilities	21	1	11	2.1
Income lost	159	130	145	27.8
Health	46	137	92	17.7
Average per household	235	107	171	-
Total			521	100.0

b. Average floor level 0.29 meter
c. Average inundation depth
1995 flood 0.39 meter
1996 flood 0.35 meter

(Estimated)

d. Building
Value $4,800
Damage ratio (below floor level) 0.032
Estimated damage **$154**
e. Assets
Value $800
Damage ratio (below floor level) 0.032
Estimated damage **$26**
d. Sub-total **$179**

Note :
Damages values in " Estimated " are those estimated by the Study Team based on a number of assumptions, while the values in " (Surveyed) "are those surveyed by Asset and Flood Damage Survey (AFDS) conducted by TEAM Consulting Engineers Co.,Ltd. as part of the present study.

Table F3-8 Estimated Inundation Damage Values Compared with Damage Values Surveyed by AFDS (3/7)

3. Small factories (1)

Total number of small factories in the Study Area : 354
Number of samples surveyed : 16

(Surveyed)

a. Average damage values declared

(Unit : $/case)

Item	1995	1996	Average	(%)
Building	10,000	0	5,000	86.7
Assets	n.a.	n.a	n.a	-
Damage on product	371	754	563	9.8
Utilities	325	0	163	2.8
Health	42	42	42	0.7
Average	2,153	517	1,335	-
Total	-	-	5,768	100.0

b. Average floor level 0.18 meter
c. Average inundation depth
1995 flood 0.52 meter
1996 flood 0.57 meter

(Estimated)

d. Building
Value $9,000
Damage ratio (within 0.5m above floor level) 0.092
Estimated damage $828
e. Assets
Value $11,300
Damage ratio (below floor level) 0.092
Estimated damage $1,040
f. Sub-total $1,868

Note :
(1) A comparison is made for small factories (workers of less than 10) only, since the average number of workers of the factories surveyed is 5.3 per factory.
(2) Damages values in " Estimated " are those estimated by the Study Team based on a number of assumptions, while the values in " (Surveyed) "are those surveyed by Asset and Flood Damage Survey (AFDS) conducted by TEAM Consulting Engineers Co.,Ltd. as part of the present study.

Table F3-8 Estimated Inundation Damage Values Compared with Damage Values Surveyed by AFDS (4/7)

4. Warehouse

Total number of warehouses in the Study Area : 134
Number of samples surveyed : 10

(Surveyed)

a. Average damage values declared

(Unit : $/case)

Item	1995	1996	Average	(%)
Building	0	0	0	0.0
Assets	n.a.	n.a	n.a	-
Damage on product	910	1,050	980	99.2
Utilities	0	0	0	0.0
Health	8	8	8	0.8
Average	914	1,054	984	-
Total	-	-	988	100.0

b. Average floor level 0.12 meter
c. Average inundation depth
1995 flood 0.36 meter
1996 flood 0.34 meter

(Estimated)

a. Building
Value $12,500
Damage ratio (within 0.5m above floor level) 0.092
Estimated damage **$1,150**
b. Assets
Value $3,400
Damage ratio (below floor level) 0.092
Estimated damage **$313**
c. Sub-total **$1,463**

Note :
Damages values in " Estimated " are those estimated by the Study Team based on a number of assumptions, while the values in " (Surveyed) "are those surveyed by Asset and Flood Damage Survey (AFDS) conducted by TEAM Consulting Engineers Co.,Ltd. as part of the present study.

Table F3-8 Estimated Inundation Damage Values Compared with Damage Values Surveyed by AFDS (5/7)

5. Office

Total number of offices in the Study Area : 438
Number of samples surveyed : 11

(Surveyed)

a. Average damage values declared

(Unit : $/case)

Item	1995	1996	Average	(%)
Building	0	10,000	5,000	89.9
Assets	n.a.	n.a	n.a	-
Damage on product	0	0	0	0.0
Utilities	1,077	50	564	10.1
Health	0	0	0	0.0
Average	1,077	10,050	5,564	-
Total	-	-	5,564	100.0

b. Average floor level 0.39 meter
c. Average inundation depth
1995 flood 0.41 meter
1996 flood 0.39 meter

(Estimated)

d. Building
Value $10,000
Damage ratio (within 0.5m above floor level) 0.092
Estimated damage **$920**
e. Assets
Value $8,800
Damage ratio (below floor level) 0.092
Estimated damage **$810**
f. Sub-total **$1,730**

Note :
Damages values in " Estimated " are those estimated by the Study Team based on a number of assumptions, while the values in " (Surveyed) "are those surveyed by Asset and Flood Damage Survey (AFDS) conducted by TEAM Consulting Engineers Co.,Ltd. as part of the present study.

TableF3-8 Estimated Inundation Damage Values Compared with Damage Values Surveyed by AFDS (6/7)

6. School

Total number of schools in the Study Area : 105
Number of samples surveyed : 17

(Surveyed)

a. Average damage values declared

(Unit : $/case)

Item	1995	1996	Average	(%)
Building	1,687	7,306	4,497	45.8
Assets	4,969	4,719	4,844	49.3
Utilities	228	735	482	4.9
Health	0	0	0	0.0
Average	3,067	6,571	4,819	-
Total	-	-	9,823	100.0

b. Average floor level 0.72 meter
c. Average inundation depth
1995 flood 0.57 meter
1996 flood 0.53 meter

(Estimated)

d. Building
Value $100,000
Damage ratio (within 0.5m above floor level) 0.032
Estimated damage $3,200
e. Assets
Value $8,800
Damage ratio (below floor level) 0.032
Estimated damage ($) $282
f. Sub-total $3,482

Note :
Damages values in " Estimated " are those estimated by the Study Team based on a number of assumptions, while the values in " (Surveyed) "are those surveyed by Asset and Flood Damage Survey (AFDS) conducted by TEAM Consulting Engineers Co.,Ltd. as part of the present study.

Table F3-8 Estimated Inundation Damage Values Compared with Damage Values Surveyed by AFDS (7/7)

7. Hospital

Total number of schools in the Study Area :	24
Number of samples surveyed :	9

(Surveyed)

Data are not available in such a way as to make a comparison with the estimated values.

(Estimate)

a. Building	
Value	$22,000
Damage ratio (within 0.5m above floor level)	0.032
Estimated damage	**$704**
b. Assets	
Value	$11,400
Damage ratio (below floor level)	0.032
Estimated damage ($)	**$365**
c. Sub-total	**$1,069**

Note :
Damages values in " Estimated " are those estimated by the Study Team based on a number of assumptions, while the values in " (Surveyed) "are those surveyed by Asset and Flood Damage Survey (AFDS) conducted by TEAM Consulting Engineers Co.,Ltd. as part of the present study.

Table F3-9 Damage Values for Mesh by Land Use Type and Inundation Level in 2010

(Unit : $)

Land use type	Inundation below floor level	Inundation above floor level				
		Less than 50 cm	50-99 cm	100-199 cm	200-299cm	300 cm -
1 Dense activities	16,890	48,854	63,676	141,563	308,042	441,742
2 Dense urban center	79,677	275,277	431,656	844,373	1,743,014	2,318,837
3 Dense residential	25,370	87,723	137,654	269,140	555,458	738,718
4 Loose residential	2,448	8,518	13,440	26,180	53,941	71,554
5 Loose activities	727	2,386	3,571	7,211	15,094	20,502
6 Agriculture land, unused land	461	1,606	2,534	4,936	10,171	13,491
7 Green space, park	0	0	0	0	0	0
8 Fish pond	428	1,511	2,411	4,661	9,570	12,628
9 Lakes, pond, river	0	0	0	0	0	0

Table F3-10 Result of Interview Surveys with District Offices on Inundation Damages (1/7) (Prampi Makhara)

Item	Item	Remark
1. Damage on infrastructure and utilities		
Road	2	Holes/hollows made
Bridge	1	
Water supply	1	
Sewerage	3	Pipes broken. Drainage clogged with waste.
Power	1	
Telecommunications		
Other		
(3 : severe damage, 2: light damage, 1: no damage)		
2. Expenditure for restoration of inundation damages		
1997		
Total	Riel 130 million	
Dredging of sewers (district expenditure)	Riel 130 million	Total length of 18,000 meters
Dredging of sewers (municipality expenditure)	not known	Total length of 3,340 meters
Restoration of roads (municipality expenditure)	not known	Total length of 1,100 meters
1998		
Total	Riel 30 million	
Dredging of sewers (district expenditure)	Riel 30 million	
** No work was made for restoration of damaged roads such as No. 139 (100 m), No.215 (300 m), and No. 182 (200 m) due to lack of fund.*		
3. Proportion of raods/streets by traffic disturbance		
Case A		
Depth of water		
% to all streets	0%	
Duration in a rainy seoson		
Duration in a day		
Case B		
Depth of water	0.5 m	
% to all streets	10%	
Duration in a rainy seoson	2 days	
Duration in a day	not known	
Case C		
Depth of water	0.3 m	
% to all streets	20%	
Duration in a rainy seoson	1 day	
Duration in a day	15 hours	
Case D		
Depth of water	0.1 m	
% to all streets	70%	
Duration in a rainy seoson		
Duration in a day	5 hours	
Case A : No traffic can pass, Case B : Only high floor vehecles can pass, Case C : All can pass, but slowly. Case D : Normal		
4. Degradation of urban function		
Normal flood	90%	
Severe flood	70%	

Table F3-10 Result of Interview Surveys with District Offices on Inundation Damages (2/7) (Toul Kork)

Item	Item	Remark
1. Damage on infrastructure and utilities		
Road	3	holes/hollows
Bridge	no bridge	
Water supply	2	Old pipes broken by trucks running over
Sewerage	3	Much waste in drains
Power	1	
Telecommunications	1	
Other		
(3 : severe damage, 2: light damage, 1: no		
2. Expenditure for restoration of inundation damages		
1997		
Total	$344,767	
- Rehabilitation of Road, new sewer construction, new manholeconstruction and	$136,624	private money
- New sewer construction and manhole	$205,643	Chinese government
- Gasoline for sewer cleaning	$2,500	district expenditure
1998		
Total	$1,133,774	
Repair of road, new sewer construction, new manhole construction, manhole and sewer	$332,587	
Rpair and construction of road	$756,850	private money
Manhole and sewer cleaning	$44,337	district expenditure
3. Proportion of raods/streets by traffic disturbance		
Case A		
Depth of water	0.5 m	
% to all streets	10%	
Duration in a rainy seoson	2 - 3 days	
Duration in a day	24 hours	
Case B		
Depth of water	-	
% to all streets	0%	
Duration in a rainy seoson	-	
Duration in a day	-	
Case C		
Depth of water	0.2 m	
% to all streets	80%	
Duration in a rainy seoson	2 - 3 days	
Duration in a day	24 hours	
Case D		
Depth of water	less than 0.2 m	
% to all streets	10%	
Duration in a rainy seoson		
Duration in a day	12 hours	
Case A : No traffic can pass, Case B : Only high floor vehecles can pass, Case C : All can pass, but slowly. Case D : Normal		
4. Degradation of urban function		
Normal flood	100%	
Severe flood	90%	Occuring every year

Table F3-10 Result of Interview Surveys with District Offices on Inundation Damages (3/7) (Dong Penh)

Item	Item	Remark
1. Damage on infrastructure and utilities		
Road	3	holes/holows
Bridge	no bridge	
Water supply	1	
Sewerage	3	Waste clogging. Sewers broken.
Power	1	
Telecommunications	1	
Other		
(3 : severe damage, 2: light damage, 1: no		
2. Expenditure for restoration of inundation damages		
1997		
Total	Riel	
Sewer restoration	Riel	
Road restoration	not known	
1998		
Total	Riel	
Sewer restoration	Riel	
Road restoration	not known	
3. Proportion of raods/streets by traffic disturbance		
Case A		
Depth of water	0.6 m	
% to all streets	30%	
Duration in a rainy seoson	3 days	
Duration in a day	8 hours	
Case B		
Depth of water	0.4 m	
% to all streets	30%	
Duration in a rainy seoson	1 day	
Duration in a day	8 hours	
Case C		
Depth of water	0.3 m	
% to all streets	20%	
Duration in a rainy seoson	25 days	
Duration in a day	8 hours	
Case D		
Depth of water	less than 0.2 m	
% to all streets	20%	
Duration in a rainy seoson		
Duration in a day		
Case A : No traffic can pass, Case B : Only high floor vehecles can pass, Case C : All can pass, but slowly. Case D : Normal		
4. Degradation of urban function		
Normal flood	80%	
Severe flood	70%	

Table F3-10 Result of Interview Surveys with District Offices on Inundation Damages (4/7) (Chamkamorn)

Item	Item	Remark
1. Damage on infrastructure and utilities		
Road	3	many holes/big holows
Bridge	no bridge	
Water supply	1	
Sewerage	3	
Power	1	
Telecommunications	1	
Other		
(3 : severe damage, 2: light damage, 1: no		
2. Expenditure for restoration of inundation damages		Restoration of roads/streets and sewerage drainage acilities
1997		
Total	Riel 3,957,500 $184,318.00	
1998		
Total	Riel 15,948,000 $76,815.00	
3. Proportion of raods/streets by traffic disturbance		
Case A		
Depth of water	0.8 m	
% to all streets	20%	
Duration in a rainy seoson	1 - 15 days	Duration in days and hours are not clear.
Duration in a day	24 hours	
Case B		
Depth of water	0.4 m	
% to all streets	8%	
Duration in a rainy seoson	1 - 15 days	
Duration in a day	24 hours	
Case C		
Depth of water	0.2 m	
% to all streets	70%	
Duration in a rainy seoson	1 - 15 days	
Duration in a day	24 hours	
Case D		
Depth of water	less than 0.2 m	
% to all streets	2%	
Duration in a rainy seoson	1 - 15 days	
Duration in a day	24 hours	
Case A : No traffic can pass, Case B : Only high floor vehecles can pass, Case C : All can pass, but slowly. Case D : Normal		
4. Degradation of urban function		
Normal flood	90%	
Severe flood	50%	Occuring every year

Table F3-10 Result of Interview Surveys with District Offices on Inundation Damages (5/7)
(Russey Keo District, Chroi Chavana Sub-ditrict)

Item	Item	Remark
1. Damage on infrastructure and utilities		
Road	3	
Bridge	no bridge	
Water supply	3	
Sewerage	1	
Power	3	
Telecommunications	3	
Other		
(3 : severe damage, 2: light damage, 1: no		
2. Expenditure for restoration of inundation damages		
1997		
Total	$25,020	
Road restoration	$25,020	4 places for 4,920 m, adding height to
Sewers restoration	not known	5 places for 1,924 meters
1998	not known	
3. Proportion of raods/streets by traffic disturbance		
Case A		
Depth of water	0.4 - 3.0 m	
% to all streets	100%	
Duration in a rainy seoson	60 days	
Duration in a day	24 hours	
Case B		
Depth of water		
% to all streets		
Duration in a rainy seoson		
Duration in a day		
Case C		
Depth of water		
% to all streets		
Duration in a rainy seoson		
Duration in a day		
Case D		
Depth of water		
% to all streets		
Duration in a rainy seoson		
Duration in a day		
Case A : No traffic can pass, Case B : Only high floor vehecles can pass, Case C : All can pass, but slowly. Case D : Normal		
4. Degradation of urban function		
Normal flood	70%	
Severe flood	30%	

Table F3-10 Result of Interview Surveys with District Offices on Inundation Damages (6/7) (Dang Kor)

Item	Item	Remark
1. Damage on infrastructure and utilities		
Road	3	Damaged in 8km in Sondor Steng
Bridge	2	
Water supply	1	
Sewerage	1	
Power	1	
Telecommunications	1	
Other		
(3 : severe damage, 2: light damage, 1: no		
2. Expenditure for restoration of inundation damages		
1997		
Total (Riel)	184 million	
Road rehabilitation in front of Century Market	63 million	
Sewerage restoration in front of a school (Riel)	131 million	
1998	n.a	
3. Proportion of raods/streets by traffic disturbance		
Case A		
Depth of water	1.0 m	
% to all streets	80%	
Duration in a rainy seoson	15 days	
Duration in a day	24 hours	
Case B		
Depth of water		
% to all streets	0%	
Duration in a rainy seoson		
Duration in a day		
Case C		
Depth of water		
% to all streets	0%	
Duration in a rainy seoson		
Duration in a day		
Case D		
Depth of water		
% to all streets	20%	
Duration in a rainy seoson		
Duration in a day		
Case A : No traffic can pass, Case B : Only high floor vehecles can pass, Case C : All can pass, but slowly. Case D : Normal		
4. Degradation of urban function		
Normal flood	100%	
Severe flood	10%	At inundation, people walk or go by boat. Many people stay at home at inundation.

Table F3-10 Result of Interview Surveys with District Offices on Inundation Damages (7/7) (Mean Chey)

Item	Item	Remark
1. Damage on infrastructure and utilities		
Road	2	Earth road damaged.
Bridge	no bridge	
Water supply	1	
Sewerage	2	Much waste clogging.
Power	1	
Telecommunications	1	
Other		
(3 : severe damage, 2: light damage, 1: no		
2. Expenditure for restoration of inundation damages		
1997		
Total (Riel)	22,800,000	
Road resotoration (Riel)	15,200,000	
Sewerage restoration (Riel)	7,600,000	
1998		
Total	0	
Road resotoration	0	
Sewerage restoration	0	
3. Proportion of raods/streets by traffic disturbance		
Case A		
Depth of water		
% to all streets	0%	
Duration in a rainy seoson		
Duration in a day		
Case B		
Depth of water		
% to all streets	0%	
Duration in a rainy seoson		
Duration in a day		
Case C		
Depth of water	0.1m<	
% to all streets	80%	
Duration in a rainy seoson	5 - 10 days	
Duration in a day	8 hours	
Case D		
Depth of water	0.05 - 0.10 m	
% to all streets	20%	
Duration in a rainy seoson		
Duration in a day		
Case A : No traffic can pass, Case B : only high floor vehecles can pass, Case C : All can pass, but slowly. Case D : Normal		
4. Degradation of urban function		
Normal flood	100%	
Severe flood	80%	

Table F3-11 Preliminary Estimate of Damages by Degraded Urban Function

Phnom Pehn's GRDP

Industry	271 billion Riel in 1996 in current price
Service	910 billion Riel in 1996 in current price
Total	1,181 billion Riel in 1996 in current price

Length of inundation (AFDS)

(Unit : days)

	1995	1996	Average
Household	22.3	20.1	21.2
Shop	17.6	14.0	15.8
Office	2.8	2.8	2.8
Factory	13.9	8.2	11.1
Warehouse	9.6	9.6	9.6
School	12.6	5.9	9.3
Total	13.1	10.1	11.6

Level of degradation of urban function

	Normal inundation	Severe inundation	Average
Maximum	30%	90%	
Minimum	0%	10%	
Average	10%	43%	26%

Derivation of Damage

GRDP	1,181 billion Riel in 1996 in current price
Length	11 days
	3.0% of 365 days
Level of degradation	26%
Damage	9.4 billion Riel in 1996 in current price
	2.5 million $ per year
Adjustment to 1998 level	none due to little gorwth in 1997 and 1998

Direct economic benefit	30.2 million $ per year
	8.2%

Note : $= 3,800 Riel

Table F3-12 Direct Flood and Inundation Damage and Economic Benefit by Component

Unit: US$

Component	Direct Damage in Without-project Case			
	2-year	5-year	10-year	30-year
1	50,000 of maintenance cost			
2	0	0	44,717,000	53,736,000
3	3,747,000	4,308,000	4,867,000	5,316,000
4	4,486,000	6,697,000	7,535,000	8,701,000
5	1,361,000	1,845,000	2,075,000	2,488,000
6	1,187,000	1,428,000	1,588,000	1,716,000
7	3,899,000	4,303,000	4,458,000	5,039,000
8	No damage			

Component	Direct Damage in With-project Case			
	2-year	5-year	10-year	30-year
1	Nil			
2	0	0	4,458,000	5,039,000
3	749,000	809,000	1,051,000	1,166,000
4	1,867,000	2,599,000	3,168,000	3,535,000
5	820,000	1,076,000	1,107,000	1,174,000
6	978,000	1,268,000	1,286,000	1,599,000
7	3,832,000	4,220,000	4,673,000	5,299,000
8	No damage			

Component	Direct Benefit			
	2-year	5-year	10-year	30-year
1	50,000			
2	0	0	40,259,000	48,697,000
3	2,998,000	3,499,000	3,816,000	4,150,000
4	2,619,000	4,098,000	4,367,000	5,166,000
5	541,000	769,000	968,000	1,314,000
6	209,000	160,000	302,000	117,000
7	67,000	83,000	(215,000)	(260,000)
8	Nil			

Table F3-13 Annual Average Benefits (1/3)

a. Component 2: Kop Srov and Tompun Dikes

Return Period	Flood Damage (US$1,000)		Benefit (US$1,000)	Mean (US$1,000)	Frequency per Year	Annual Average Benefit (US$1,000)
	Without-Project	With-Project				
0.2-year	0	0	0			
				0	4.500	0
2-year	0	0	0			
				0	0.300	0
5-year	0	0	0			
				26,168	0.100	2,617
10-year	58,132	5,795	52,337			
				57,821	0.067	3,851
30-year	69,857	6,551	63,306			
Total	-	-	-	-	-	6,468

b. Component 3: Tompun Watershed

Return Period	Flood Damage (US$1,000)		Benefit (US$1,000)	Mean (US$1,000)	Frequency per Year	Annual Average Benefit (US$1,000)
	Without-Project	With-Project				
0.2-year	0	0	0			
				1,949	4.500	8,769
2-year	4,871	974	3,897			
				4,223	0.300	1,267
5-year	5,600	1,052	4,549			
				4,755	0.100	475
10-year	6,327	1,366	4,961			
				5,178	0.067	345
30-year	6,911	1,516	5,395			
Total	-	-	-	-	-	10,856

Note: 30 % of indirect damage has been included in the values above.

Table F3-13 Annual Average Benefits (2/3)

c. Component 4: Trabek Basin

Return Period	Flood Damage (US$1,000)		Benefit (US$1,000)	Mean (US$1,000)	Frequency per Year	Annual Average Benefit (US$1,000)
	Without-Project	With-Project				
0.2-year	0	0	0			
				1,702	4.500	7,661
2-year	5,832	2,427	3,405			
				4,366	0.300	1,310
5-year	8,706	3,379	5,327			
				5,502	0.100	550
10-year	9,796	4,118	5,677			
				6,196	0.067	413
30-year	11,311	4,596	6,716			
Total	-	-	-	-	-	9,933

d. Component 5: City Core North Area

Return Period	Flood Damage (US$1,000)		Benefit (US$1,000)	Mean (US$1,000)	Frequency per Year	Annual Average Benefit (US$1,000)
	Without-Project	With-Project				
0.2-year	0	0	0			
				352	4.500	1,582
2-year	1,769	1,066	703			
				852	0.300	255
5-year	2,399	1,399	1,000			
				1,129	0.100	113
10-year	2,698	1,439	1,258			
				1,483	0.067	99
30-year	3,234	1,526	1,708			
Total	-	-	-	-	-	2,050

Note: 30 % of indirect damage has been included in the values above.

TableF3-13 Annual Average Benefits (3/3)

e. Component 6: Pochentong East Basin

Return Period	Flood Damage (US$1,000)		Benefit (US$1,000)	Mean (US$1,000)	Frequency per Year	Annual Average Benefit (US$1,000)
	Without-Project	With-Project				
0.2-year	0	0	0			
				136	4.500	611
2-year	1,543	1,271	272			
				240	0.300	72
5-year	1,856	1,648	208			
				300	0.100	30
10-year	2,064	1,672	393			
				272	0.067	18
30-year	2,231	2,079	152			
Total	-	-	-	-	-	731

f. Component 7: Northeast and Northwest Areas

Return Period	Flood Damage (US$1,000)		Benefit (US$1,000)	Mean (US$1,000)	Frequency per Year	Annual Average Benefit (US$1,000)
	Without-Project	With-Project				
0.2-year	0	0	0			
				44	4.500	196
2-year	5,069	4,982	87			
				98	0.300	29
5-year	5,594	5,486	108			
				-86	0.100	-9
10-year	5,795	6,075	-280			
				-309	0.067	-21
30-year	6,551	6,889	-338			
Total	-	-	-	-	-	196

Note: 30 % of indirect damage has been included in the values above.

Table F3-14 Annual Average Benefit for Rice Production (1/2)

a. Component 2 : Kop Srov and Tompun Dikes

Return Period	Flood Damage (US$)		Benefit (US$)	Mean (US$)	Frequency per Year	Annual Average Benefit (US$)
	Without-Project	With-Project				
0.2-year	0	0	0			
				0	4.500	0
2-year	0	0	0			
				0	0.300	0
5-year	0	0	0			
				158,593	0.100	15,859
10-year	317,185	0	317,185			
				336,938	0.067	22,440
30-year	356,690	0	356,690			
Total	-	-	-	-	-	38,299

b. Component 3 : Tompun Watershed

Return Period	Flood Damage (US$)		Benefit (US$)	Mean (US$)	Frequency per Year	Annual Average Benefit (US$)
	Without-Project	With-Project				
0.2-year	0	0	0			
				1,344	4.500	6,046
2-year	3,280	593	2,687			
				2,445	0.300	734
5-year	3,367	1,164	2,203			
				2,285	0.100	228
10-year	3,775	1,409	2,366			
				2,353	0.067	157
30-year	3,879	1,540	2,339			
Total	-	-	-	-	-	7,164

Table F3-14 Annual Average Benefit for Rice Production (2/2)

c. Component 6 : Pochenton East Basin

Return Period	Flood Damage (US$)		Benefit (US$)	Mean (US$)	Frequency per Year	Annual Average Benefit (US$)
	Without-Project	With-Project				
0.2-year	0	0	0			
				637	4.500	2,864
2-year	4,586	3,313	1,273			
				1,118	0.300	335
5-year	5,532	4,570	962			
				1,542	0.100	154
10-year	6,805	4,684	2,121			
				1,812	0.067	121
30-year	7,116	5,614	1,502			
Total	-	-	-	-	-	3,474

d. Component 7 : Northeast and Northwest Areas

Return Period	Flood Damage (US$)		Benefit (US$)	Mean (US$)	Frequency per Year	Annual Average Benefit (US$)
	Without-Project	With-Project				
0.2-year	0	0	0			
				204	4.500	918
2-year	44,331	43,923	408			
				963	0.300	289
5-year	51,544	50,026	1,518			
				147	0.100	15
10-year	54,384	55,608	-1,224			
				-1,608	0.067	-107
30-year	60,830	62,821	-1,991			
Total	-	-	-	-	-	1,115

Table F3-15 Standard Conversion Factor in Cambodia

Equation :

SCF = (Import + Export) / (Import + Export - Export Tax + Import tax)

** SCF : standard conversion factor*

Item	Unit	1996	1997
Export	$ million	644	734
Import	$ million	1,072	1,103
Customs duties	$ million	336	337
Export tax	$ million	8	10
Standard Conversion Factor	coefficient	0.84	0.85

Source :

(1) Monthly Bulletine of Statistics September 1998, Ministry of Economy and Finance

(2) Data provided by Ministry of Economy and Finance