3. CONDITIONS SET UP FOR FLOOD DAMAGE ESTIMATION

3.1 Premises for Flood Damage Estimation

3.1.1 Components of Flood Damage

Fig.3.1.1 shows the components of flood damage. Flood damage has been divided into two categories: (1) tangible damage and (2) intangible damage. The latter, which includes negative psychological impact such as fear, depression and health, etc., was excluded from the damage analysis because it is next to impossible to estimate such psychological conditions.

Tangible damage has further two categories: (1) direct damage and (2) indirect damage. Direct damage is measurable and often referred to as the damage. Indirect damage is not physical but subsequent negative effect on economic activities. Sales loss, for instance, is atypical indirect damage due to business suspension in a shop forced to close by inundation. Direct damage also includes loss of tourism and expenses for disease and so on.

Direct damage consists of damage to households, commerce, industry, agriculture, fishery, livestock and public utilities.

3.1.2 Data for Damage Amount Estimation

Damage amount is the total of direct damage and indirect damage, a function of inundation depth and duration (Fig. 3.1.2). In the Study, direct damage is physical damage expressed as economic value of assets (building and assets except land) in each sector. According to the statistics on agriculture, direct damage consists of loss of harvest, damage on livestock, and loss of fish and damage on aqua-culture facilities. Indirect damage is subsequent negative result of inundation. Inundation occasionally forces economic activities to stop for a few days or more (business suspension due to flood). Employees, for instance, may not have access to their working places and shops may close due to direct damages. In these cases, employees may lose part of their salary due to leaves of absence (income loss) and shops may lose sales expected (sales loss). Along the Chao Phraya River, flood inundation continues for a few months from place to place and this indirect damage will become worthy of consideration as the country further develops.

There is no authorized methodology to estimate damage amount, and there are no available data of damage rate or unit cost to estimate the damage amount, although the concept of damage estimation is known in Thailand. There are some methodologies or damage rates in some reports by PWD, but these are not authorized and are different depending on the report. Damage amount is estimated differently case by case. In some cases damage rate is set up as baht/household or baht/km^2 without unit cost.

Flood damage information is categorized into household, agriculture, commerce, industry and other sectors. For each sector, direct damage amount is represented as the idea in Fig. 3.1.3, the damage on assets. Flood damage at a certain inundation depth is calculated by the equation below:

$$Total\ Damage\ Amount = \Sigma(Damaged\ Quantity \times Unit\ Value \times Damage\ Rate) + Indirect\ Damage\ Amount$$

As for the flood damage data, the basic data are concerned with each category mentioned above. In addition to these data, the damage rate and unit value are needed when the damage amount is estimated.

To calculate the damage amount in each sector, the whole damage amount can be estimated. In this process, the damaged quantity should be understood and the unit cost and damage rate should be set up. Damage rate is concerned with inundation depth, and also duration in case of agriculture.

3.1.3 Distribution of Assets Value in the Study Area

Table 3.1.1 shows the data on number or area of houses, commerce, industry and agriculture. These data are concentrated in the lower delta including Bangkok. On the other hand, the agricultural area is distributed in the upper central plain and higher delta.

Table 3.1.2 and Fig. 3.1.4 show the data on the distribution of assets value in the study area taking into consideration the assets value and farm gate price set up in Subsection 3.2 Assets value is mainly concentrated in the lower delta including Bangkok. Agricultural value shares just 0.67% in the total assets value. Thus, most asset values are in the private sector covering houses, commerce and industry.

3.2 Set Up Conditions

3.2.1 Unit Value

To consider unit value, there are the unit values of main buildings and of assets except land. The National Statistics Office provided thematic values; that is, (1) the national survey on industry (NSO, 1992), and (2) the national survey on commerce (NSO, 1994) as the source of asset-value in the damage estimation system. Further, the proportion between commercial and residential buildings from the interview survey is applied to the data in (2) to set a value for residential buildings and assets owing to inaccessibility to official statistics on the subject. The Study Team applied an appropriate economic factor to the values in 1998 for the estimation (Table 3.2.1).

3.2.2 Damage Rate in Private Sector

Flood damage rate is the proportion between direct damage amount and assets value (Fig. 3.2.1). The deeper is the inundation, the larger the rate becomes. The damage rate on houses has been derived as shown in the following table mainly from the survey by RID in 1997 and referring to the results of flood damage survey. This has been applied to the other three sectors (commerce, industry and other establishments) as well, since no significant difference was observed in the damage rate of these sectors.

Damage Rate Below Floor Level (Unit: %)

Inundation depth (m)	House/damage rate	Assets/damage rate
0≤ × <0.5	0	0
0.5≤ ×	3	0

Damage Rate Above Floor Level (Unit: %)

Inundation depth (m)	House/damage rate	Assets/damage rate
0≤ × <0.5	3	1
0.5≤ × <1.0	5	8
1.0≤ × <1.5	7	13
1.5≤ × <2.0	8	17
2.0≤ ×	9	19

3.2.3 Damage Rate in Agricultural Sector and Farm Gate Price

Damage rate has been set, considering RID, Indonesian study and Japanese practice. Farm gate price has been set, considering RID practice. (See Table 3.2.2.)

3.3 Methodology of Flood Damage Estimation

3.3.1 Direct Damage

Direct damage has been calculated as follows:

(1) Household, Commerce, Industry and Public Utility

Flood damage for household, commerce, industry and public utility is calculated at a given depth, as follows:

Flood Damage of a Sector = Value of building × Damage Rate (a) + Value of assets × Damage Rate (b) *(1)*

Flood Damage of this section = Σ(Damage of Residence, Commerce, Industry and other establishments) *(2)*

To estimate these kinds of damage, floor type is divided into two, high floor and low floor, in the structural point of view, because damage rate is influenced by the structural feature very much.

(2) Agriculture, Livestock, Fishery

Agricultural damage is calculated as follows:

One type of damage = area × yield × farm gate price × damage rate *(3)*

Agricultural damage = Σ(damage of rice, field crops, vegetable and fruit) *(4)*

For other major categories, livestock and fishery, their proportion in total agricultural damage amount is derived from the statistics on flood damage amount in 1995 and 1996. Damage rate of livestock is 0.7% and that of fishery is 10% of the total agricultural damage.

Then, subsequently, two other damages can be calculated:

Livestock damage = (4) × 0.7/100 (5)

Fishery damage = (4) × 10/100 (6)

(3) Public Utility

(a) Rural Area

Since agricultural areas abound in the rural area, public utilities are greatly related to agriculture. If the damage amount for public utilities is drawn from the total agricultural damage amount of the 1995 flood, the damage to public utilities would be 70% of the total agricultural damage.

Then, subsequently, two other damages can be calculated, as follows:

Public utility damage in rural area = (4) × 70/100 (7)

(b) Urban area

Since the agricultural area in the urban area is very small compared with the agricultural areas in the rural area, the method under the above Item (a) cannot be adopted for the calculation of damage to public utilities. Therefore, the method used in Japan has been adopted and the damage amount for public utilities was computed; i.e., the damage amount of public utility is 52% of the total damage of general properties like households, commerce, industry and other establishments.

Then subsequently, two other damages can be calculated, as follows:

Public utility damage in urban area = (1) × 52/100 (8)

3.3.2 Indirect Damage

Although statistics on income and sales is available, it has been impossible to draw the relation between income or sales loss and inundation depth. With the developing condition of Thailand, however, the estimation of such indirect damage cannot be neglected. In the Japanese practice, which was successfully applied to similar studies in the neighboring countries, indirect damage is assumed to be 6% of direct damage and this was applied to the Study.

Further, expressway or trunk road damage is not considered in the estimation of indirect damage. The Department of Highways commented that these roads were well prepared for flooding in terms of budget and material, and freight economy could not be much negatively influenced.

3.4 Flood Damage Estimation in the Past Floods

Damage amount has been estimated for representative floods in 1983, 1995 and1996. The estimated damage amount in the objective study area is 71, 72 and 32 billion baht, respectively, as shown Table 3.4.1. This estimation is under the situation in 1998.

The inundation volume in 1995 is larger than that in 1983, although the damage amount is almost the same, because the ring levee around Bangkok where buildings and assets are concentrated, were not yet completed in 1983.

Flood damage amount in each sector is high in the order of industry, commerce, and households. If the damage amounts of these three sectors are added, they will become a little more than 90% of the whole damage amount. Other damage amounts including agriculture are 10% or less of the whole damage amount.

If the damage amounts for industry, commerce, and households are distributed among the four areas (Upper Central Plain, Nakhon Sawan Area, Higher Delta, Lower Delta), the damage in each sector would concentrate on the Lower Delta. With regard to the other sector containing agriculture, the damage amount will concentrate on the Higher Delta, because the agricultural area is large and the inundation is deep in this area.

The Ministry of Interior estimated the damage amount including the private sector in the year 1995 in its report on flood damage for 1995. If the damage in the private sector is taken into account, the damage amount would come to about 50 billion baht. This official damage amount including the whole sector estimated by the Ministry of Interior is nearly the same as the estimation result in this Study.

Therefore, the simulation model is considered to be appropriate.

4. FLOOD DAMAGE ESTIMATION FOR THE MASTER PLAN

4.1 Introduction

Based on the premises described in Section 1 to Section 3 above, flood damage amount was estimated with-project and without-project for the Master Plan. "Without-project" means the future basin condition in 2018 as discussed in Sector VI, Flood Mitigation Plan, and "with-project" means the condition where a proposed project is added to the future basin condition. "Project benefit" means the damage reduction from the "without-project" to "with project" situations.

4.2 Flood Damage Estimation for Without Project Situation

4.2.1 Precondition

The target year of the Master Plan is 2018. Since the value of buildings and assets set up in Section 3 are values under the condition in 1998, preconditions were set up to estimate the damage amount under the future basin condition in 2018 for each flood event, as follows:

- The value of buildings and assets as well as crops was set based on the growth rate of per capita income and population in the year 2018, as shown Table 4.2.1.
- The plans prepared by PWD with 100-year return period of ring dike surrounding urban areas were set up. Flood damage estimations exclude the areas protected under the PWD plans.
- In Bangkok, since the protection works (design water level is 2.4 m at Samsen) will be made as planned, the damage amount by floods in which the phenomenon exceeding design water level occurs was calculated on the basis of the relation between inundation volume and damage amount, as shown Fig. 4.2.1.
- The ground levels were modified by considering the probable future land subsidence in and around Bangkok.

4.2.2 Annual Average Damage Amount

The hydraulic parameters of inundation depth were calculated by hydraulic simulation for every flood event, as discussed in Sector I, Hydrology and Flood Simulation; namely, 45 floods from 1952 to 1996. Flood damage without the project was accordingly calculated for every case of flood event applying the hydraulic parameters to the methods of flood damage estimation as discussed in the previous section. The results of calculation in each of the 45 floods are shown in Fig. 4.2.2 and Table 4.2.2.

Annual average damage amount was calculated as the average for 45 floods. Annual average damage amount without project was estimated to be 24,239million baht in the whole objective area.

Annual Average Damage Amount Without Project

Area	Annual Average Damage Amount
Bangkok Area	4,200 million baht
Rural Area	20,039 million baht
Whole Objective Area	24,239 million baht

4.3 Flood Damage Estimation for With Project Situation

In addition to the precondition in the previous section, the precondition for the situation with project was set up depending on applicable measures set up in the Master Plan, as discussed in Sector VI, Flood Mitigation Plan. The applicable measures were divided into two types, the nonstructural measure and structural measures. Flood damage estimation for the with-project situation was carried out in both cases of individual application of measures and combination of measures.

(1) Individual application of measures

(a) Nonstructural measures

The nonstructural measure is the modification of dam operation rule selected from several nonstructural measures for damage estimation with project.

- Modification of dam operation rule

(b) Structural Measures

Structural measures consist of the following:

- River improvement from Chainat to Pathum Thani
- Ayuthaya-East-Sea diversion
- Heightening of ring levee along the river in Bangkok
- Drainage system improvement in the lower central plain
- Distribution system improvement

(2) Combination of measures

In this study, the Master Plan is formulated consisting of structural and non-structural measures. In the Master Plan, for flood mitigation in the urban areas of Phathum Thani, Nonthaburi and Bangkok, the three alternatives are provided as the following:

- Alternative 1 : Partial protection of Pathum Thani and Nonthaburi
- Alternative 2-1 : Heightening of flood barrier at Bangkok
- Alternative 2-2 :Construction of diversion channel

In case of alternative 1, flood damage estimation includes the damage in the urbanareas where are not protected in both Pathum Thani and Nontaburi.

4.4 Benefit Estimation for Each Project

Benefit is the difference of effects at the time when projects are implemented or not. The benefit for each project was calculated by the following formula. The representative floods in 1983, 1995, 1996 were chosen for the estimation of the benefit.

$$Benefit = Annual\ Average\ Damage\ Amount \times (\Sigma wop - \Sigma wp) / \Sigma wop$$

Here;

Σwop = Σ(*damage amount of representative floods without project*)

Σwp = Σ(*damage amount of representative floods with project*)

Benefit for each project provided is shown in Table 4.4.1.

5. FLOOD DAMAGE ESTIMATION FOR THE FEASIBILITY STUDY

5.1 Introduction

5.1.1 Ojective Project

In the Master Plan, several project components have been proposed for flood mitigation in the Chao Phraya River Basin, consisting of structural and nonstructural measures. Modification of dam operation rule, land use control and guidance, institutional and organizational arrangement, and river improvement have been selected for the Feasibility Study. Among these project components, flood damage estimation was carried out for two components, the modification of dam operation rule and the river improvement.

5.1.2 Future Condition

The target year of the objective projects is 2005, and this damage amount estimation is carried out for the future basin condition in 2005. The conversion rates of asset values from 1998 to 2005 are assumed based on the projected land use and growth rates of population and per capita income as shown in Table 4.2.1.

5.2 Modification of Dam Reservoir Operation

Target dam reservoirs are Sirikit, Bhumibol and Pasak. Benefits to be generated by the modification of the dam reservoir operation are estimated for four cases, namely three individual cases of each dam and a combination case of the three dams.

5.2.1 Flood Damage Amount Without-Project

The effectiveness of the proposed modification is expressed as a difference of flooding condition between before and after the proposed modification. As discussed in Sector VIII, "Integrated Dam Operation Plan", the following rules are applied as the rules before the modification, namely the without-project condition:

Dam Reservoir	Rule before Modification
Bhumibol	Current Rule (Observed Outflow)
Sirikit	Rule proposed by JICA KIN Study
Pasak	Conventional Operation

Flood simulations are made for 33 years from 1964 to 1996 as discussed in Sector I, "Hydrology and Flood Simulation". Flood damage amounts in all the flood events are estimated by using hydraulic parameters obtained the flood simulations as shown in Table 5.2.1. Then, the annual average damage amount are calculated as follows:

Annual Damage Amount Without Project

Area	Annual Damage Amount (bil. Baht/year)
Bangkok Area	2.1
Other Areas	13.5
Total	15.6

5.2.2 Flood Damage Amount With-Project

In the combination case of the three dam, flood simulations are conducted for all the 33 years, but only ten representative floods, in 1972, 1973, 1979, 1983, 1984, 1985, 1987, 1992, 1995 and 1996 are applied in the individual dam cases. Using the obtained hydraulic parameters, flood damage amounts in all the flood events are calculated as presented in Table 5.2.1.

5.2.3 Expected Benefit

The benefit, namely the reduction of the annual average damage amount to be derived from the proposed modification is calculated in the following equation.

$$Benefit = Annual\ Average\ Damage\ Amount \times (\Sigma wop - \Sigma wp)/\Sigma wop$$

Here;

Σwop = Σ(*damage amount of representative floods without project*)

Σwp = Σ(*damage amount of representative floods with project*)

In the combination case of the three dams, all the 33 floods are applied as the representative floods.

The estimated benefit are tabulated as follows:

Benefit of Modification of Dam Reservoir Operation (mil. baht/year)

Objective Dam	Bangkok	Other Areas	Total
Sirikit	225	271	496
Bhumibol	25	43	68
Pasak	135	472	607
Combination of above three dams	299	868	1,167

Note:Above benefits are under the future basin condition in 2005.

5.3 River Improvement

Five cases of the river improvement are conceived, namely one case for the 3-year improvement and four cases for the 5-year one as follows:

Conceivable Cases for River Improvement

Case No.	Protection Level	Protection Area of River Improvement	Area (km2)
5-1	5-yr	Area-1	410
5-2	5-yr	Area-1 to 2	1,260
5-3	5-yr	Area-1 to 3	1,330
5-4	5-yr	Area-1 to 4	1,510
3	3-yr	Area-1, 4,5,6,7 and 8	2,035

5.3.1 Flood Damage Amount Without-Project

The modification of the dam operation is very effective for flood mitigation with less cost, according to Sector VIII. Moreover, it can be implemented soon if the agreement is reached among the agencies concerned. For the Feasibility Study on the river improvement, therefore, it is assumed that the dam operation modification has been completed before the implementation of the river improvement. This means that the without-project condition for the river improvement includes the proposed modification of the dam operation.

The 1957 and 1996 floods which nearly correspond to the 3-year and 5 year floods respectively in terms of the discharges at the Chao Phraya Dam are applied for the flood simulation under the without-project condition. Using the obtained hydraulic parameters, flood damage amounts for all the problem areas given in Fig. 5.3.1 are calculated as shown in Table 5.3.1.

5.3.2 Flood Damage Amount With-Project

Flood simulations are conducted under the proposed river improvement plans for the 3-year and 5-year flood events in 1957 and 1996 respectively, and corresponding flood damage amounts are estimated as presented in Table 5.3.1. This table gives differences between the damage amounts with- and without-project.

5.3.3 Expected Benefit

Based on the estimated flood damage by each probable discharge, the benefit, the annual average damage reduction is calculated as presented in Table 5.3.2. Since the 5-year Improvement plans are partial protection plans, these improvement works increase flood damage in the unprotected areas, although they reduce flood damage in the protected areas. In Table 5.3.2 damage amount reductions are calculated for the positive and negative ones separately, and summarized in Table 5.3.3.

Tables

Table 2.1.1 : DATA AVAILABILITY

	Unit	Availability	Remarks
Provincial statistics			
Total area	hectare	Yes	every district
Population	number	Yes	every district
Household	number	Yes	every district
Commerce	number	Yes	every district, large or small
Industry	number	Yes	every district, large or small
Agriculture	hectare	Yes	every district, every crops
Actual damage data			
Household	number	Yes	whole and partial
	amount	No	
Commerce	number	No	
	amount	No	
Industry	number	No	
	amount	No	
Other establishment	number	Yes	school, temple, official building, etc.
	amount	Yes	
Agriculture	area	Yes	
	amount	Yes	
Fishery	number	Yes	fish pond, shrimp pond
	amount	No	
Livestock	number	Yes	
	amount	No	
Infrastructure	number or meter	Yes	road, bridge, irrigation
	amount	Yes	
Whole damage amount	amount	Yes	including private sector, only in 1995
Damage amount estimation			
Methodology		Unauthorized	
Damage rate			
House		Unauthorized	
Commerce		Unauthorized	
Industry		Unauthorized	
Agriculture		Unauthorized	

Table 2.1.2 (1/2) FLOOD DAMAGE IN 1995 (DOLAS SURVEY)

No	Province	Life and Private Properties						Public Utilities							Agriculture			Fishery	Lives Stock
		Effect to population				Home Damage		Road	Bridge	Dam	School	Temple	Office	Other	Paddy Field	Farming	Gardening	Fish Pond/Shrimp Farm	Lives stock dead
		Household	Person	Dead	Displace	Whole	Partial	(number)	(number)	(number)	(number)	(number)	(number)	(number)	(Rai)	(Rai)	(Rai)	(number)	(Head)
	Northern																		
1	Chiang Rai	78,776	298,230	11	816	6	14	786	168	134	13	5	8	65	233,588	49,987	2,421	4,246	42,459
2	Lampang	7,428	26,346			23	30	122	14	33				11	17,725			238	42,579
3	Pichit	70,586	294,503	40	4,476	3	13	1,271	8	83	98	66	32	32	1,000,335	12,088	33,289	11,171	179,312
4	Mea Hong Som	11,138	38,585		23	3	2	135	57	246				1	6,525	305		23	960
5	Uthaithani	16,248	71,480	10	1,200			344	25	50	50	40	35	1	85,076			1,237	60,075
6	Chiangmai	24,151	120,854	3	1,236	15	17	168	32	93	3	4		26	64,282			840	163
7	Payao	40,970	148,931	2	740	52	1,159	572	120	36				43	69,774	61,230	2,000	3,909	130,963
8	Prae	78,020	189,019	3	15	23	21	354	77	71		16			92,241	17,380	117	483	115,405
9	Petchabun	26,234	109,328	5				579	8	6					220,608	13,240	290	5,878	57,342
10	Sukhothai	43,803	160,679	8	506			705	8	3	23	81	2	20	485,723	28,009	3,070		158,685
11	Pitsanulok	47,233	208,846	19	486	2,300	6,658	574	31	37	70	66			591,257			4,349	53,420
12	Nan	28,442	109,717	4	652	20	47	491	61	145	2	5	2	56	48,703	3,484	329	987	19,628
13	Uttaradit	31,358	81,449	13		6		592	57	91	10	20	5	17	282,610	14,210	3,114	2,691	22,833
14	Nakorn Sawan	71,409	260,061	40	2,421			494	1	9	44	46	10	1	1,036,987	62,992	38,190	6,126	12,976
15	Lum Phun	448	1,344					81	16	39	1			6	1,332	679	1,216	51	
16	Tak	12,280	62,744	1				201	19	68				15	105,241			396	9,585
17	Kampangpet	1,500	4,716				1	255		3					58,323	3,947	858	8	1,149
	Total	590,024	2,186,832	159	12,571	2,451	7,962	7,724	702	1,147	314	349	94	294	4,400,330	267,551	84,894	42,633	907,534
	North Eastern																		
1	Nong Bau Lumphu	12,322	70,655	2	3	1	1	131	15	1	2	2			70,582			4,345	2,578
2	Kon Kaen	953	5,233	6			13	110		10		1			133,641	120	2,090	4,873	400
3	Udorn Thani	11,073	57,627	3	45		10	527	20	47		1			275,367			6,250	40,468
4	Chaiyaphum	45,858	199,214	3		34		595	30	116	2	13		13	123,549	7,452	906	8,847	8,155
5	Nakorn Rajasima	457	2,094	4				430		13		1		2	54,723				4,026
6	Nong Khai	43,352	182,233	4				493	15	12	43	4	1	2	440,386			12,147	72,250
7	Burirum	11,514	51,646	2				105		1				3	141,805	1,760		219	5,568
8	Kalasin	9,428	54,040					316	15	45			1	9	8,378		72	656	16
9	Srisuket							490	2						5,389				22
10	Loei	192	486			3	16	84	2	6				1	15,065				
11	Sakonnakorn	21,243	111,742	8			7	219	5	7					128,386			120	15,576
12	Mahasalakam	3,467	9,902	2				472		7					28,808			1,460	26
13	Nakorn Phanom	34,864	98,741	3	3,199			619	25	33	24	17	8	78	284,883			3,995	30,276
14	Yasothorn	8,758	37,321					226	1	2				6	25,883	15			1
15	Roi-et	2,235	11,175					1,031	2	6					123,594				
16	Surin	654	1,962					142							7,778				1
17	Ubol	474	2,889					475	7						4,809				
18	Mukdahan	7,641	39,481		50		1	86	15	4			3		5,267				100
19	Amnajchareon	10	61					31							1,150				1
	Total	214,495	936,502	37	3,297	38	48	6,582	154	310	71	39	13	114	1,879,443	9,347	3,068	42,910	179,464

Table 2.1.2 (2/2) FLOOD DAMAGE IN 1995 (DOLAS SURVEY)

No	Province	Life and Private Properties						Public Utilities							Agriculture			Fishery	Lives Stock
		Effect to population				Home Dange		Road	Bridge	Dam	School	Temple	Office	Other	Paddy Field	Farming	Gardening	Fish Pond/Shrimp Farm	Lives stock dead
		Household	Person	Dead	Displace	Whole	Partial	(number)	(number)	(number)	(number)	(number)	(number)	(number)	(Rai)	(Rai)	(Rai)	(number)	(Head)
	Eastern																		
1	Trat	1,665	5,137	1	18		2	71	10	2									
2	Prachinburi	31,519	78,456	10	136	1	30	564	15	11	60	92	7		2,400		23,950	124	7,532
3	Sakeaw	12,012	39,647					217	4	3					444,461		96,520	1,542	215,561
4	Chantaburi	12,142	48,567		155		1	394	7	6	3	1		64	170,621		54,200		11,040
5	Rayong	6,062	18,085	2				68	3						453		1,302	2	10,893
6	Cholburi	7,981	2,418	2				341							13,011			635	7,200
7	NakornNayok	16,982	68,425	6			1	73	1						7,032		552		26,470
8	ChacheongSao	19,802	51,725		4,020			257	6		23	15	3		176,163		65,010	3,059	75,296
															180,330		42,420	3,815	55,428
	Total	108,165	312,460	21	4,329	1	34	1,985	46	22	86	108	10	64	994,471	-	283,954	9,177	409,420
	Central																		
1	Petchburi	6,300	28,420	1				73	2	11		25		8	37,187		11,200	402	1,373
2	Kanchanaburi	409	3,403			2	5	198							39,106			106	8,122
3	Lopburi	46,624	179,089	30	4,491			850	10	10	89	95	18	12	244,684	96,127	31,016		35,516
4	Saraburi	25,561	58,406	3	13,977			273	10	16	23	27	20		148,548	4,493	375	2,229	34,561
5	Chainat	14,231	51,825	13	294			195	2	4	40	37	10		101,522	2,330	42,500	972	24,042
6	Ayutthaya	72,955	209,944	70	1,732			1,071	76		219	281	113		371,449		59,173	947	264,847
7	Singburi	25,126	80,192	22	14,720			98		34				2	190,725	65	15,323	71	60,841
8	Angthong	29,165	89,312	22	1,573	72	167	180	4	1	27	42	25	1	199,105	5,788	16,329	1,029	139,932
9	Nonthaburi	56,244	149,912	6				135	1		171	114	15		181,211	895	42,426	373	425
10	Pratumthani	69,406	263,132	24	1,935			164			110	105			147,510		24,141	2,603	20,457
11	Samutprakarn	1,357	25,356					17			4	3			19,612		31,508		
12	Samutsakorn	14,317	42,951					33										9	
13	Suphanburi	29,576	137,447	5				659	3						208,441	4,845	11,220	3,584	450,458
14	Nakorn Prathom	48,318	223,373					714	4		25	21			235,755		53,000	1,300	1,026
15	Prachuapkirikhan	3,311	5,200	3		2	76	340	20	14	22	8	1		1,244	6,151	2,728	91	17,624
16	Samutsongkram	200	539					8											
	Total	443,100	1,548,501	199	38,722	76	248	5,008	132	90	730	758	202	23	2,126,099	120,694	340,939	13,716	1,059,224
	Southern																		
1	Ranong	129	531				1	18	9									205	
2	Chumporn	18,339	75,507	7		1	1	338	33	6				2	32,301	6,498	42,150	145	44,688
3	Satul	8,505	46,958					175	21		3			3	29,049		19,200	93	15,305
4	Suratthani	14,565	73,856	3	691	11	293	965	34	13	8	7	1	44	25,245	11,694	16,082	2,476	42,807
5	Pang-nga	1,375	2,421					80	10		3	2		1	3,075		542	36	
6	Krabi	200	800					71							944	2,141	3,172		
7	Trang	5,185	20,160	1	1,202	3	1,749	457	33	22	5	4		1	9,275	420	27,100	1,427	12,088
8	Yala	7,855	39,125	1			8	372	25	9			1	51	350	55	10	71	1,391
9	Pattalung	44,662	205,797	2	9,606	2	15	767	118	69	89	45	18	269	101,247	1,336	11,964	3,736	53,615
10	Songkhla	34,555	189,595	2	571	7	376	820	52	21	52	52	9	91	100,386	445	8,257	1,140	7,625
11	Narathiwat	11,962	51,715				2	469	69	1	32	5		18	13,694	624	2,095	398	51,832
12	Pattani	18,705	47,659		7	2	49	559	5	11	32	1	16	76	17,372	192,758	35,215	63	1,380
13	N. Srithamrat	47,716	214,925	10	9,504	11	59	2,051	145	38	93	44	16	72	341,374	6,754	19,924	2,257	27,518
	Total	213,753	969,049	26	21,581	37	2,553	7,142	554	190	317	160	61	628	674,312	222,725	185,711	12,047	258,249
	Grand Total	1,569,537	5,953,344	442	80,500	2,603	10,845	28,441	1,588	1,759	1,518	1,414	380	1,123	10,074,655	620,317	898,566	120,483	2,813,891

Table 2.2.1 (1/4) INTERVIEW FORM TO GOVERNMENT OFFICES

JAPAN INTERNATIONAL COOPERATION AGENCY
ROYAL IRRIGATION DEPARTMENT
Flood Damage Survey

Form of Questionnair — for Provincial / District Office / RID Regional Office (3, 7 and 8)

Reference:			
Date	day	month	year
Name of interviewer			
Signature			
Location of interview			
Remarks (if any)			

A. Office Address

Office name	
Representative	
Street	
Village (muban)	
Town (tambon)	
District (amphoe)	
Province (changwat)	
Telephone number	
Fax number	
Administrative area (square km)	

Table 2.2.1 (2/4) INTERVIEW FORM TO GOVERNMENT OFFICES

B. Population / Households / Farm

Flood event

		1995		1996		1983		19xx	
	Normal	Dead	Injured	Dead	Injured	Dead	Injured	Dead	Injured
Population									
		Completely damaged	Partially damaged	Completely damaged	Partially damaged	Completely damaged	Partially damaged	Completely damaged	Partially damaged
Number of household									
Number of farms									

C. Building statistics

Flood event

Put number of each type of building.	Normal	1995 Completely damaged	1995 Partially damaged	1996 Completely damaged	1996 Partially damaged	1983 Completely damaged	1983 Partially damaged	19xx Completely damaged	19xx Partially damaged
Residence									
Upper class residence									
Middle class residence									
Low class residence									
Shop									
Factory									
Office (public and private)									
School									
Hospital									
Clinic									
Religious places									

Table 2.2.1 (3/4) INTERVIEW FORM TO GOVERNMENT OFFICES

D. Agricultural statistics

Crop / Plant type	Crop Area (ha)	Yield (ton / ha)	Farm Gate Price (Baht / ton)	Total Farm Gate Price (Bt)	Flood Event (1995, 1996 and any significant case)			
					Initial date of inundation	Duration of inundation	Maximum depth of	Damage (Baht)
Rice (major crop)								
Rice (second crop)								
Maize								
Sugarcane								
Soy bean								

E. Public Facilities

		1995			1996			19xx		
	Normal	Completely	Partially	Suspended	Completely	Partially	Suspended	Completely	Partially	Suspended
Transport										
National road (km)										
Regional road (km)										
Bridge (number of unit)										
Irrigational facilities										
Intake (number of unit)										
Watergate (number of unit)										
Irrigational canal (km)										
Others ( )										

Table 2.2.1 (4/4) INTERVIEW FORM TO GOVERNMENT OFFICES

F. Public service

	1995	1996	1983	19xx	19xx
	Suspended period of service (days)	Suspended period of service (days)	Suspended period of service (days)	Suspended period of service (days)	Suspended period of service (days)
Postal service					
Electricity					
Telecommunication					
Water supply					
Transport system					

G. Actions taken against flood

	1995	1996	19xx	19xx	19xx
	yes or no	yes or no	yes or no	yes or no	yes or no
Flood warning					
Flood fighting					
Evacuation					
Compensation to victims (Baht)					

H. Flood record

	Town 1	Town 2	Town 3	Town 4						
Case in 1995	write town name									
Inundated area (ha)										
Duration of inundation (days)										
Date of starting inundation										
	Town 1	Town 2	Town 3	Town 4						
Case in 1996										
Inundated area (ha)										
Duration of inundation (days)										
Date of starting inundation										
	Town 1	Town 2	Town 3	Town 4						
Case in 19xx										
Inundated area (ha)										
Duration of inundation (days)										
Date of starting inundation										

Thank you very much for your cooperation.

Table 2.3.1 INTERVIEW SURVEY ON IN MAJOR CITIES

Name of city	Population	Major flood year	Flood damage	Cause of flood	Flood fighting	Notes	Referring figure no.
Bangkok	5,570,743	1975		Rapid urbanization & land subsidence		1,100 million baht damage	
		1980		ditto		450 millon baht damage	
		1982		ditto			
		1983		ditto		6,597 million baht damage	5.1.1
		1995		ditto			5.1.2
		1996	Flood mainly occurred along Chao Phraya River.	ditto		High tide worsened damage.	
Sukhothai	39,004	1995	City center was inundated (2 mons).	Small discharge capacity	Heighting flood protection dikes		
		1996	Western part of the city was inundated.	ditto	ditto	City center had no damage.	
Phitsanulok	91,143	1995	Residential area was inundated (1 mon).		No flood fighting system		
		1996	Eastern part of city was inundated.		ditto		
Phichit	57,276	1994			ditto		
		1995	Eastern part of the city was inundated w/ 1.5 m depth.		ditto		5.1.3
		1996	Eastern part of the city was inundated w/ 1.5 m depth.		ditto		5.1.3
Nakhon Sawan	145,636	1970		No protection dike			
		1980					
		1995	Average inundation depth was 0.6 m.				5.1.4
Chai Nat	19,706	1994			Forming a flood fighting team		
		1995	Northern part of city was inundated w/ 2 m depth.		Spent 5 million baht for flood fighting		5.1.5
		1996	Northern part of city was inundated w/ 2 m depth.		Spent 5 million baht for flood fighting	Flood damage was 86 million baht.	
Sing Buri	21,329	1984					
		1995			Building protection dikes		5.1.6
		1996	Flood area was 3 sq. m.			23 million baht damage.	
Ang Thong	21,183	1995			Heightening protection dikes	City center was protected.	5.1.7
		1996	Commercial area was inundated w/ 1. 8 m depth (2 days).		1,000 people engaging in flood fighting	Backwater also caused damage.	
Ayutthaya	70,367	1995	Whole city was inundated (2 mons).		Forming a flood fighting team	65 million baht damage	
		1996			Dredging canals, constructing dikes	City was protected.	

Table 2.3.2 FLOOD AND OTHER DAMAGES ON AGRICULTURE (1984-1993)

		Damaged Area (Rai)										
		Rice	Corn	Ground-nuts	Mung-bean	Soy-beans	Sugar cane	Cassava	Other	Vegetable	Fruit	Total
1983/84	Drought	219,203	902,613	12,047	19,053	11,994	496,158	97,871	20,094	9,910	1,475	1,790,418
	Flood	3,985,614	74,545	8,945	45,041	5,623	83,153	89,903	66,666	74,452	65,757	4,499,699
	Other	212	47	-	-	-	-	-	-	-	5	264
	Total	4,205,029	977,205	20,992	64,094	17,617	579,311	187,774	86,760	84,362	67,237	6,290,381
1984/85	Drought	1,252,661	794,638	24,779	40,141	21,236	8,409	376	29,891	363	-	2,172,494
	Flood	660,838	87,115	324	13,961	21,271	-	304	3,296	15,588	2,171	804,868
	Other	180	168,969	-	-	-	-	-	-	-	-	169,149
	Total	1,913,679	1,050,722	25,103	54,102	42,507	8,409	680	33,187	15,951	2,171	3,146,511
1985/86	Drought	419,506	468,230	5,930	2,548	1,181	88,322	545	3,124	261	171	989,818
	Flood	320,848	51,751	2,295	78,581	43,090	8,384	7,294	33,932	9,134	3,001	558,310
	Other	73	-	-	-	295	-	-	-	100	3,276	3,744
	Total	740,427	519,981	8,225	81,129	44,566	96,706	7,839	37,056	9,495	6,448	1,551,872
1986/87	Drought	4,100,984	1,948,240	25,561	23,038	5,947	4,464	22,261	91,047	267	-	6,221,809
	Flood	732,354	44,808	14,330	4,478	28,105	9,067	3,141	17,355	9,300	11,789	874,727
	Other	4,076	-	-	-	-	-	-	-	-	20	4,096
	Total	4,837,414	1,993,048	39,891	27,516	34,052	13,531	25,402	108,402	9,567	11,809	7,100,632
1987/88	Drought	5,388,361	3,024,444	61,480	23,343	466,185	130,309	163,557	2,197,495	42,254	194	11,497,622
	Flood	1,546,351	42,138	8,863	58,448	20,429	68	12,751	83,929	21,180	8,209	1,802,366
	Other	-	-	-	-	-	-	-	-	-	-	0
	Total	6,934,712	3,066,582	70,343	81,791	486,614	130,377	176,308	2,281,424	63,434	8,403	13,299,988
1988/89	Drought	2,259,166	201,609	1,873	6,411	576	-	-	50,685	1,130	-	2,521,450
	Flood	2,777,727	133,755	1,454	94,167	55,752	34,229	76,742	162,029	74,811	256,611	3,667,277
	Other	-	-	-	-	444	-	-	341	-	1,649	2,434
	Total	5,036,893	335,364	3,327	100,578	56,772	34,229	76,742	213,055	75,941	258,260	6,191,161
1989/90	Drought	2,301,832	784,617	7,646	37,941	21,385	11,026	13,770	169,648	7,582	10,748	3,366,195
	Flood	380,703	23,018	811	481	180,246	-	-	11,440	791	265	597,755
	Other	290,014	695	125	12,990	8,191	-	-	49,094	30,223	790,994	1,182,326
	Total	2,972,549	808,330	8,582	51,412	209,822	11,026	13,770	230,182	38,596	802,007	5,146,276
1990/91	Drought	2,981,355	1,713,762	6,257	29,035	84,645	55,010	9,024	171,022	8,297	23,261	5,081,668
	Flood	4,891,219	53,085	4,833	170	22,954	7,336	63,896	109,125	28,205	145,196	5,326,019
	Other	6,711,556	615	32	-	8,219	-	-	1,674	2,272	1,504	6,725,872
	Total	#########	1,767,462	11,122	29,205	115,818	164,739	72,920	281,821	38,774	169,961	17,133,559
1991/92	Drought	1,326,506	1,592,610	22,694	21,593	336,096	164,739	35,771	189,853	8,876	1,316	3,700,054
	Flood	4,224,995	80,428	2,032	9,011	9,059	3,719	43,185	147,569	10,992	18,489	4,549,479
	Other	34,424	54	9	160	308	-	-	1,495	6,274	1,381	44,105
	Total	5,585,925	1,673,092	24,735	30,764	345,463	168,458	78,956	338,917	26,142	21,186	8,293,638
1992/93	Drought	4,612,249	491,758	16,482	25,641	339,748	160,112	73,929	750,727	9,790	224,951	6,705,387
	Flood	1,561,912	44,618	2,952	27,028	19,990	11,716		203,799	29,358	72,113	1,973,486
	Other	1,382,361	3,029	-	-	18,445	-	30	1,263	103	18,296	1,423,527
	Total	7,556,522	539,405	19,434	52,669	378,183	171,828	73,959	955,789	39,251	315,360	10,102,400

Table 2.3.3 FLOOD AND DROUGHT DAMAGE BY REGION

1) DAMAGED FARMLAND BY FLOOD (rai)

region	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93
North	350,286	1,178,206	177,793	3,093,488	5,671,555	104,119	757,873	1,563,894	2,194,302	1,562,174
N. Eastern	217,809	337,810	420,340	2,138,854	2,522,391	2,355,067	1,156,704	661,802	437,976	3,330,688
Central	463,011	286,034	14,709	692,760	1,400,348	62,264	383,196	899,079	479,987	813,804
East	31,776	86,617	162,522	43,381	529,261	-	80,825	370,998	32,761	468,756
West	726,385	259,591	214,454	234,527	1,362,426	-	275,720	349,504	547,021	508,882
South	1,151	24,236	-	18,799	11,641	-	711,877	1,236,391	8,007	21,083
Total	1,790,418	2,172,494	989,818	6,221,809	11,497,622	2,521,450	3,366,195	5,081,668	3,700,054	6,705,387

2) DAMAGED FARMLAND BY DROUGHT (rai)

region	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93
North	988,582	1,346,686	464,039	3,211,813	6,283,908	986,724	1,205,604	4,974,126	3,964,586	3,661,236
N. Eastern	1,279,327	531,499	518,700	2,235,631	3,040,909	2,492,587	1,296,822	2,655,705	2,847,051	3,744,776
Central	1,384,841	356,737	95,584	734,183	1,739,097	314,749	552,202	4,448,633	565,777	869,150
East	1,152,039	255,619	169,460	368,241	529,396	260,575	81,631	2,136,981	275,778	526,108
West	1,400,932	259,591	304,059	319,493	1,392,234	521,262	390,245	1,675,731	593,486	702,388
South	84,660	396,379	30	231,271	314,444	1,615,264	1,619,773	1,242,383	46,960	598,742
Total	6,290,381	3,146,511	1,551,872	7,100,632	13,299,988	6,191,161	5,146,277	17,133,559	8,293,638	10,102,400

Table 2.3.4 (1/2) RICE CULTIVATION AREA DAMAGED BY FLOOD

Region/ Province	Year									
	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93
										(rai)
North-Eastern										
Nakhon Phanom	394	19,764	3,899	-	18,650	-	-	144,481	173,772	-
Sakon Nakhon	3,059	33,624	-	9,987	46,504	-	13,826	158,436	87,205	-
Nong Khai	49,794	-	3,707	3,020	2,615	3,896	4,438	84,312	72,368	17,068
Udon Thani	12,880	19,388	1,968	12,797	55,049	15,046	27,640	144,860	15,909	53,033
Nong Bua Lam Phu*										
Loei	-	-	-	-	3,596	710	1,756	173	4,332	-
Mukdahan	-	-	-	-	-	-	-	3,612	19,490	-
Yasothon	50,257	-	6,643	-	-	-	23,436	89,087	131,276	33,473
Ubon Ratchathani	36,690	52,081	7,120	-	40,534	636	7,841	62,141	155,120	31,241
Amnat Charoen*										
Kalasin	21,406	1,029	-	16,513	12,599	-	1,200	108,044	125,320	5,373
Khon Kaen	1,965	-	-	646	25,450	49,538	979	85,610	185,610	-
Maha Sarakham	40,268	-	766	-	-	-	1,953	26,138	231,435	-
Roi Et	177,262	-	31,560	-	8,436	-	38,844	156,507	325,070	63,937
Buri Ram	126,337	-	-	45,969	2,414	-	-	16,708	179,047	20,197
Si Sa Ket	107,001	38,004	565	-	33,108	-	-	22,075	99,939	62,731
Surin	68,994	21,532	-	2,608	-	-	3,951	1,940	118,435	32,716
Chaiyaphum	-	5,875	40,880	-	43,657	28,015	-	135,730	219,881	-
Nakhon Ratchasima	302,514	143	-	1,577	181,498	6,292	-	184,667	166,597	-
Northern										
Nakhon Sawan	238,979	-	41,987	-	29,033	235,158	-	9,322	143,165	112,612
Phetchabun	1,358	43,116	19,846	-	135,741	-	1,805	14,146	413,071	23,470
Uthai Thani	129,376	-	-	314	71,278	109,959	-	16,250	-	32,150
Kamphaeng Phet	106,293	-	1,774	14,686	2,707	136,494	4,653	-	158,911	92,873
Tak	4,811	181	805	-	-	19,683	-	-	4,733	9,431
Phichit	1,018	2,524	1,847	-	26,936	-	51,376	-	570,384	-
Phitsanulok	4,740	1,432	23,119	-	31,002	7,925	48,199	12,603	253,187	135,902
Nan	-	2,715	2,777	283	-	-	40	121	-	-
Phrae	-	-	-	-	-	-	-	-	-	10
Lampang	-	-	-	-	762	-	-	-	-	388
Sukhothai	17,319	454	12,714	32,195	47,657	47,707	47,048	14,565	10,193	75,496
Uttaradit	-	-	-	-	3,671	-	25,581	19,498	9,132	29,260
Chiang Mai	29,637	-	-	5,864	67,226	4,639	16,839	6,196	20,306	6,524
Chiang Rai	-	74,207	44,313	2,133	65,879	20,397	23,248	56,430	59,030	369
Mae Hong Son	119	859	2,804	1,027	4,229	-	519	-	3,383	-
Lamphun	334	-	-	192	8,226	-	-	-	893	5,916
Phayao	924	4,041	-	-	29,992	1,818	-	28,729	-	38,636
Central Plain										
Lop Buri	34,377	-	44,428	-	149,769	8,063	523	136,240	54,276	-
Saraburi	31,406	-	4,750	30,561	11,197	747	-	187,740	-	7,811
Chai Nat	30,240	-	-	-	29,042	84,864	12,023	13,100	-	21,124
Nakhon Nayok	105,629	-	1,398	14,056	-	31,527	806	440,805	70,209	-
Nakhon Pathom	41,796	-	-	3,119	-	7,806	-	-	-	5,133
Nonthaburi	8,674	-	-	-	-	-	-	194	-	-
Pathum Thani	164,135	-	-	1,331	715	13,313	-	247,297	-	-
Ayutthaya	222,522	-	-	-	406	13,115	-	468,634	-	1,965
Sing Buri	9,556	-	-	-	55,842	15,396	-	49,625	-	2,284

Table 2.3.4 (2/2) RICE CULTIVATION AREA DAMAGED BY FLOOD

Region/ Province	Year									
	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93
Suphan Buri	402,448	-	-	37,784	25,167	329,546	-	330,197	-	61,324
Ang Thong	110,138	-	-	-	10,224	78,138	2,457	191,160	-	6,363
Bangkok Metropolis	191,996	-	554	-	-	3,442	-	161,695	105	-
Kanchanaburi	36,474	-	7,434	13,978	-	49,387	-	24,910	2,591	14,340
Prachuap Khiri Khan	569	-	-	-	384	-	-	-	2,802	760
Phetchaburi	3,843	-	9,896	-	-	-	16,578	-	4,057	22,127
Ratchaburi	234	-	1,886	6,204	-	12,106	3,144	1,267	204	-
Chachoengsao	358,242	-	-	46,614	-	54,210	-	431,651	27,455	-
Prachin Buri	406,021	-	-	233,999	-	67,011	-	569,751	62,205	-
Sa Kaeo*										
Samut Sakhon	11,290	-	431	-	-	357	-	-	-	-
Samut Prakan	59,844	-	-	-	-	-	-	-	-	114
Samut Songkhram	-	-	977	-	-	-	-	-	-	25
Chon Buri	107,384	-	-	-	-	17,136	-	25,905	9,342	47,905
Rayong	28,643	-	-	-	135	12,668	-	795	-	3,808
Chanthaburi	3,546	-	-	719	-	100	-	3,150	3,550	-
Trat	-	-	-	305	-	-	-	-	-	-
Southern Region										
Chumphon	-	1,072	-	4,106	1,200	25,309	-	-	10,100	552
Nakhon Si Thammarat	12,776	274,964	-	6,603	119,540	681,658	-	-	-	347,348
Phatthalung	-	24,940	-	22,191	-	85,688	-	4,507	-	-
Songkhla	14,771	-	-	50,455	29,040	261,732	-	-	3,650	89,743
Surat Thani	-	9,828	-	16,246	13,273	117,409	-	-	-	23,204
Krabi	-	-	-	577	-	813	-	-	-	-
Trang	-	13,814	-	21,539	757	27,456	-	-	2,309	-
Phangnga	218	-	-	1,131	190	-	-	-	-	-
Phuket	1,350	-	-	250	-	-	-	-	-	-
Ranong	-	-	-	-	118	31	-	-	-	-
Satun	-	-	-	2,970	-	4,850	-	-	5,079	440
Narathiwat	-	10,243	-	26,919	24,343	15,595	-	-	3,495	1,846
Pattani	53,763	-	-	36,888	54,941	52,066	-	-	2,172	19,285
Yala	-	5,008	-	3,998	21,619	18,275	-	215	4,200	1,605

*** no information taken for newly established pro vinces**

Table 2.3.5 (1/5) AGRICULTURAL AREAS DAMAGED FLOOD IN 1995 AND 1996

(Summary of Flood Area from Gary Depression and Influence of Lots Depression)
Details of December 1995

Item	Province	Flood area (Rai)							Damage area							No.of farmer
		Rice	Corn	Soy-Bean	Vegetable	Fruits	Others	Total	Rice	Corn	Soy-bean	Vegetable	Fruits	others	Total	(families)
65	Total	11,408,653	532,005	196,136	133,486	645,608	711,244	13,627,132	10,109,016	384,925	171,316	106,897	459,747	412,399	11,644,300	922,365
	North	4,725,323	346,760	160,258	42,145	187,791	347,604	5,809,861,	4,447,025	286,235	136,048	33,298	131,845	144,038	5,178,489	387,632
1	Chiengmai	69,582	0	301	4,674	9,192	175	83,924	69,582	0	301	3,811	9,192	20	82,906	21,669
2	MaeHongson	23,167	0	1,284	10	1	888	25,350	7,635	0	1,284	10	1	883	9,818	2,384
3	Lamphun	2,199	0	628	1,317	2,566	489	7,199	1,179	0	628	1,011	908	0	3,726	828
4	Lampang	28,859	587	275	950	1,363	1,420	33,454	20,839	2,123	275	950	407	242	24,836	7,633
5	Chiengrai	290,638	58,846	110	1,669	1,637	1,064	354,014	290,638	50,368	110	1,281	1,681	1,064	345,142	33,699
6	Prayao	157,085	80,909	0	1,396	2,213	88,122	329,705	157,065	80,909	155	1,040	2,213	5,189	246,571	46,100
7	Prae	100,808	23,015	3,178	2,715	33,700	25,319	188,735	35,059	20,885	3,178	1,524	14,575	3,449	78,670	17,742
8	Nan	61,938	31,389	179	1,323	10,836	4,037	109,702	27,517	8,963	179	672	5,524	662	43,517	11,812
9	Utraradit	168,475	34,343	33,022	6,868	17,927	9,130	269,765	168,475	15,222	26,633	3,130	10,933	39,977	228,390	21,898
10	Pitsanuloke	520,248	13,751	7,154	1,541	9,251	1,256	553,201	520,248	7,944	7,154	1,541	5,327	1,256	543,470	28,254
11	Sukhothai	530,638	0	63,410	3,977	26,785	62,094	686,904	436,936	0	50,901	2,909	8,814	29,711	529,271	44,442
12	Nakornsawan	1,043,288	58,630	5,809	10,946	18,498	27,686	1,164,857	989,947	54,881	342	10,946	18,498	27,686	1,102,300	47,171
13	Pichit	1,006,848	0	0	572	32,794	11,986	1,052,200	1,000,335	0	0	487	32,794	12,120	1,045,736	42,137
14	Petchaboon	358,107	7,630	0	1,339	1,139	6,500	374,715	358,107	7,280	0	1,339	1,139	3,778	371,643	23,313
15	Kampaengpet	255,332	0	6,632	278	68	6,552	268,862	255,332	0	6,632	233	68	6,552	268,817	15,470
16	Uthaitanee	66,232	7,472	30	1,774	5,994	83,512	165,014	66,232	7,472	30	1,774	5,994	41,068	122,570	9,647
17	Tak	41,899	30,188	38,246	796	13,777	17,374	142,280	41,899	30,188	38,246	640	13,777	6,356	131,106	13.433
	Northeast	3,094,246	10,492	2,400	1,600	12,282	33,228	3,154,248	2,472,411	9,445	1,429	1,284	9,983	23,624	2,518,176	283,716
18	Nongkay	465,314	900	0	208	3,176	0	469,598	465,200	900	0	208	3,176	0	469,504	38,592
19	Sakolnakorn	210,365	0	0	0	0	0	210,365	175,607	0	0	0	0	0	175,607	62,852
20	Nakornpanom	369,787	0	0	0	39	603	370,429	320,332	0	0	0	39	603	320,974	24,948
21	Udorntanee	608,737	5	0	11	341	60	609,154	303,866	0	0	0	0	60	303,926	24,973
22	Roi-Ad	142,801	0	0	0	71	100	142,972	144,295	0	0	0	60	100	144,455	16,011
23	Yasothorn	31,190	0	0	0	0	0	31,190	19,558	0	0	0	0	0	19,558	3,303
24	Chaiyapoom	207,640	0	0	179	362	2,893	211,074	207,640	0	0	179	362	2,893	211,074	22,037
25	Nakornratsrima	150,289	2,150	70	994	1,171	5,750	160,424	106,378	1,740	62	879	430	5,306	114,795	8,893
26	Nongbualumpoo	91,634	3,060	1,374	10	0	214	96,292	88,051	2,428	472	4	0	214	91,169	9,543
27	Konkien	256,542	120	506	142	1,680	1,543	260,533	99,762	120	506	14	645	780	100,827	10,215
28	Mahasarakam	113,547	0	0	0	0	6,690	120,237	113,547	0	0	0	0	293	113,840	11,730
29	Loey	16,215	4,257	450	56	270	11,340	32,588	11,778	4,257	389	0	106	11,340	27,870	4,002
30	Surin	140,634	0	0	0	4,381	1,279	146,344	140,684	0	0	0	4,381	776	145,841	11,510
31	Kalasin	41,475	0	0	0	92	1,172	42,739	38,174	0	0	0	92	1,172	39,438	4,319
32	Ubonratchatani	22,908	0	0	0	7	2	22,917	14,022	0	0	0	0	0	14,022	82
33	Mukdahan	7,076	0	0	0	15	16	7,107	7,076	0	0	0	15	16	7,107	14,111
34	Amnartcharoen	4,748	0	0	0	0	0	4,745	4,127	0	0	0	0	0	4,127	46
35	Bureerum	163,737	0	0	0	677	1,566	165,980	163,737	0	0	0	677	71	164,485	12,931
36	Srisaket	49,557	0	0	0	0	0	49,557	49,557	0	0	0	0	0	49,557	3,618

Table 2.3.5 (2/5) AGRICULTURAL AREAS DAMAGED FLOOD IN 1995 AND 1996

(Summary of Flood Area from Gary Depression and Influence of Lots Depression)
Details of December 1995

Item	Province	Flood area (Rai)							Damage area							No.of farmer
		Rice	Corn	Soy-Bean	Vegetable	Fruits	Others	Total	Rice	Corn	Soy-bean	Vegetable	Fruits	others	Total	(families)
	Central	1,936,564	148,302	2,919	45,509	196,419	85,965	2,415,698	1,735,643	61,572	3,280	39,778	182,971	79,606	2,101,850	148,474
37	Lopburi	465,631	134,560	624	3,817	13,624	34,201	652,457	458,346	47,837	624	3,817	13,624	34,201	558,419	29,082
38	Kraburi	125,509	13,670	2,295	268	2,765	28,578	173,085	125,509	13,670	2,656	268	2,765	28,578	173,446	8,121
39	Sinburi	183,558	72	0	2,314	10,958	5,589	202,491	171,982	65	0	2,255	8,912	4,366	187,580	11,061
40	Chainat	110,795	0	0	1,683	14,688	895	128,061	62,428	0	0	1,683	13,155	421	77,637	8,599
41	Nontaburi	100,800	0	0	9,445	50,594	8,411	169,610	39,054	0	0	9,445	50,594	8,411	107,864	14,862
42	Ayuttaya	558,487	0	0	3,825	57,121	5,659	625,092	558,487	0	0	3,825	57,121	1,631	621,064	47,833
43	Patumtani	147,510	0	0	8,787	15,354	138	171,769	127,340	0	0	8,371	13,061	110	148,882	7,226
44	Angthong	156,614	0	0	11,264	19,846	1,745	189,469	149,033	0	0	8,224	16,592	1,733	175,582	16,748
45	Bangkok	87,680	0	0	4,106	11,109	749	103,644	43,464	0	0	890	6,787	155	51,296	4,942
	East	1,130,398	3,554	30,559	11,282	149,167	135,315	1,460,275	1,020,669	4,779	30,559	3,951	70,483	69,698	1,200,139	50,522
46	Trad	4,515	0	0	33	24,444	1,763	30,755	0	0	0	0	21,169	1,763	22,932	732
47	Chonburi	17,666	0	0	50	100	29,711	47,527	7,032	0	0	50	77	29,711	36,870	1,286
48	Jantaburi	353	0	0	0	2,112	810	3,275	232	0	0	0	123	810	1,165	67
49	Rayong	8,625	33	0	220	28,191	17,666	54,735	58,879	33	0	220	3,072	8,677	17,881	1,870
50	Sakaew	133,475	3,481	30,559	3,449	4,553	25,276	200,793	79,078	4,706	30,559	1,014	1,468	11,137	127,962	6,000
51	Nakornnayok	266,472	0	0	44	12,025	34,201	312,742	266,472	0	0	44	12,025	2,276	280,817	11,605
52	Prachinburi	468,683	40	0	0	10,722	2,256	481,701	445,797	40	0	0	4,891	2,256	452,984	13,919
53	Chachoengsao	203,052	0	0	1,010	35,340	22,810	262,212	203,052	0	0	1,010	24,426	12,662	241,150	12,237
54	Samutprakarn	27,557	0	0	6,476	31,680	822	66,535	13,127	0	0	1,613	3,232	406	18,378	2,806
	West	494,303	14,097	0	30,887	63,773	106,541	709,601	424,708	14,094	0	27,605	54,859	94,693	615,939	49,341
55	Supanburi	267,909	404	0	4,630	34,152	13,726	320,821	267,909	404	0	4,441	34,152	8,406	315,312	24,852
56	Kanchanaburi	64,888	13,685	0	8,575	2,888	51,938	141,974	64,888	13,685	0	10,800	2,114	32,310	123,797	8,845
57	Ratchaburi	23,016	0	0	2,097	3,253	8,737	37,103	3,782	0	0	306	134	1,455	5,677	782
58	Petchburi	57,533	8	0	1,671	10,487	1,912	71,611	7,372	5	0	11	8,361	28,293	44,042	5,583
59	Nakornpatom	80,112	0	0	11,788	11,431	24,229	127,560	80,112	0	0	11,788	9,057	24,229	125,186	7,891
60	Prachubkirekan	845	0	0	2,126	1,562	5,999	10,532	645	0	0	259	1,041	0	1,945	1,388
	South	27,799	8,800	0	2,063	36,176	2,591	77,429	8,560	8,800	0	1,981	9,606	740	29,687	2,680
61	Ranong	4,923	0	0	0	650	0	5,573	0	0	0	0	0	0	0	0
62	Pang-nga	68	0	0	183	9,692	0	9,943	58	0	0	183	2,228	0	2,469	191
63	Chumporn	2,045	8,800	0	1,760	6,266	1,200	20,071	2,045	8,800	0	1,760	6,266	5	18,876	851
64	Satul	17,552	0	0	105	3,246	207	21,110	4,075	0	0	23	422	100	4,620	1,068
65	Trang	3,211	0	0	15	16,322	1,184	20,732	2,382	0	0	15	690	635	3,722	570

Table 2.3.5 (3/5) AGRICULTURAL AREAS DAMAGED FLOOD IN 1995 AND 1996

Department of Promotion Agricultural
Collected data December 18,1996

Item	Province	Flood area (Rai)						Damage area						No.of farmer
		Rice	Farm	Vegetable	Trees	Others	Total	Rice	Farm	Vegetable	Trees	Others	Total	(families)
67	Total	12,117,983	1,891,248	369,894	999,925	241,127	15,620,177	9,229,367	1,172,664	287,122	533,025	23,597	11,245,775	938,002
17	North	4,432,751	824,319	58,434	127,515	6,715	5,449,734	3,628,449	509,304	52,689	109,072	1,358	4,301,930	263,310
1	Kampaengpetch	536,991	77,190	2,291	19,245	531	636,248	372,447	63,763	2,112	16,131	477	454,930	28,566
2	Chiengrai	75,564	63,249	1,435	783	-	141,031	40,672	31,433	947	613	-	73,665	8,635
3	Chiengmai	19,803	30	3,228	3,946	52	27,059	17,077		3,216	1,992	52	22,337	5,267
4	Tak	37,120	108,396	1,206	12,196		159,418	32,907	89,433	1,171	12,196		135,707	9,254
5	Nakornsawan	929,436	114,929	26,369	15,075	515	1,086,324	645,739	82,800	26,267	14,497	515	969,518	45,916
6	Nan	6,881	18,322	1,628	663		27,494	4,062	10,219	173	460		14,919	3,403
7	Pichit	880,169	16,169	4,930	28,445	46	929,759	697,620	14,325	4,033	24,373	46	740,397	33,831
8	Pisanulok	720,819	68,998	3,058	11,496	102	804,473	619,334	33,000	2,485	8,424	102	663,345	37,646
9	Petchaboon	390,516	79,446	5,314	2,557		477,833	359,417	21,608	4,512	1,964		387,501	20,514
10	Prae	2,626	6,200	15			8,841	526		15			541	168
11	Prayao		2,560		10	80	2,650	0	0	0	0	0	0	0
12	Maehongson	2,955	7,359	40			10,354	1,813	5,305	40			7,158	1,582
13	Lampang	6,950	139	1,311	435	60	5,895	4,923	139	1,194	100	44	6,400	1,754
14	Lampoon	12,685	2,311	3,570	5,218	5,000	28,784	4,571	612	3,185	2,531		11,099	3,972
15	Sukhothai	440,125	77,522	866	3,917	293	522,723	350,504	54,112	806	3,623	86	409,131	31,081
16	Utaradit	120,414	13,107	334	1,204		135,059	106,890	10,014	199	820		117,923	10,830
17	Uthaitanee	249,697	167,892	2,839	10,328	36	430,792	169,947	92,341	2,329	9,164	36	273,817	20,641
19	Northeast	3,894,802	121,864	44,395	26,004	18,089	4,105,154	2,912,104	93,370	36,866	11,673	733	3,054,746	281,160
1	Kalasin	43,745			36		43,781	36,007			36		36,043	4,857
2	Konkaen	154,737	8,744	1,066	376	4	164,929	140,491	8,744	960	376	4	150,575	16,544
3	Chaiyapoom	144,090	7,456	1,970	5	12,930	167,051	124,636	201		13		124,650	16,163
4	Nakornpanom	316,072					316,072	214,479					124,479	22,406
5	Nakornratsrima	602,639	50,193	30,472	11,631	290	695,495	510,404	49,092	25,644	4,932	195	590,267	53,415
6	Bureerum	274,213	6,404	21	1,252		261,590	215,175	4,752	16	1,109		221,052	18,177
7	Mahasarakam	131,577	3,474		347		135,398	99,008					99,008	11,158
8	Yasotorn	228,550	3,400	400	6,200		238,550	121,541	674		147		122,362	13,584
9	Roi-Ad	198,568			996		199,564	152,656			996		153,652	16,134
10	Loey	28,354	22,139	2,501	1,325	4	54,323	27,210	14,678	2,501	1,325	4	45,918	-
11	Srisaket	346,843	4,732	5,779	1,642	564	359,560	344,044	4,732	5,779	1,276	523	356,354	34,126
12	Sakonnakorn	250,307	1,103				251,410	171,808	533				172,341	15,464
13	Surin	295,474	6,673				302,147	197,230	4,830	80			202,140	22,571
14	Nongkay	253,390		1,627	264		255,281	178,750		1,627	264		180,641	16,801
15	Udorntanee	332,878		89			332,967	168,167		79			168,246	14,393
16	Ubonratthanee	182,132	2,343	35	1,871	4,290	190,671	129,930	2,065	25	1,155		133,195	-
17	Mukdahan	32,602	5,203	163	59	7	38,034	18,611	2,849	155	44	7	21,666	4,099
18	Nongbualumpoo	18,731					18,731	10,594					10,594	1,248
19	Amnartcharoen	59,300					59,300	51,363					51,363	-

Table 2.3.5 (4/5) AGRICULTURAL AREAS DAMAGED FLOOD IN 1995 AND 1996

Department of Promotion Agricultural
Collected data December 18,1996

Item	Province	Flood area (Rai)						Damage area						No.of farmer
		Rice	Farm	Vegetable	Trees	Others	Total	Rice	Farm	Vegetable	Trees	Others	Total	(families)
1	Bangkok	26,232		788	1,845	2,332	31,200	8,170		759	1,296	738	10,963	1,697
2	Chainat	232,452	31,912	4,664	7,376	301	276,705	209,525	23,302	4,664	7,376	301	245,168	20,526
3	Nontaburi	27,216		8,660	33,112	3,482	72,470	27,216		8,660	33,112	3,482	72,470	13,721
4	Patumtanee	80,880		9,256	19,403	541	110,080	45,657		6,751	11,764	190	64,362	5,943
5	Ayutthaya	236,002	352	6,650	25,212		268,216	171,000	352	3,407	25,212		200,031	22,952
6	Lopburi	114,732	53,897	2,435	5,043	10,177	186,284	81,334	43,393	563	2,517	347	128,454	8,573
7	Saraburi	99,716	45,098	770	1,370		146,954	60,167	27,061	770	1,370		89,368	4,491
8	Sinburi	87,413	925	739	4,997	300	94,374	79,444	925	164	4,997	226	85,756	7,342
9	Angthong	89,794	10,090	6,966	10,078		116,928	88,126	8,215	6,796	8,496		111,634	11,117
8	East	511,982	77,940	4,131	25,766	5,024	624,843	273,554	54,430	1,667	9,638	1,406	340,915	20,018
1	Jantaburi				1,780		1,780				345		345	193
2	Chachoengsao	71,680	22,480	260	7,050		101,470	67,145	8,893	255	1,194		77,487	4,371
3	Chonburi	46,520	200	1,650	215	35	48,620	37,649	126	133	115		38,023	1,700
4	Trad	160			500		660	53			245		298	49
5	Prajinburi	255,287	6,016	205	1,851		263,359	156,677	4,471	168	1,429		162,765	6,476
6	Rayong	30	3,253		1,626		4,909	30	2,110		1,315		3,455	303
7	Samutprakarn			56	10,854	4,989	15,899			30	4,464	1,406	5,900	1,623
8	Sakaew	138,305	45,991	1,960	1,890		188,146	12,000	38,830	1,281	531		52,642	5,303
8	West	1,250,359	709,123	210,593	337,643	170,861	2,678,579	1,058,347	397,745	151,553	144,661	4,088	1,756,394	152,345
1	Kanjanaburi	283,031	243,993	63,192	11,988	1,137	603,341	279,176	235,701	63,155	11,459	922	590,413	40,392
2	Rachaburi	168,342	58,860	55,372	104,084	1,352	388,010	107,985	14,562	44,693	37,020	1,352	205,812	24,008
3	Nakornpatom	120,428	14,161	53,051	14,489	1,180	203,309	113,009	1,964	16,392	8,460	440	140,265	12,403
4	Pachubkireekan	32,351	128,793	13,442	35,503	164,975	375,064	16,047	29,531	8,532	17,061	63	71,234	9,621
5	Petchaburee	160,212	5,055	4,902	32,621		222,790	118,768	3,066	3,290	22,574		147,698	15,702
6	Samutsakorn	15		2,491	16,837	44	19,387	15		1,147	3,425	44	4,631	1,220
7	Samutsongkam	2,165		1,562	81,513	287	85,527	1,878		1,562	7,693	48	11,181	4,657
8	Supanburee	463,815	258,261	16,581	40,608	1,886	781,151	421,4-09	112,921	12,582	36,969	1,219	585,160	44,342
6	South	25,429	7,650	1,305	43,356	10,140	87,880	22,923	6,117	1,205	15,614	5	45,864	6,030
1	Satul	2,050					2,050	566					566	149
2	Chumporn	22,463	7,650	1,204	29,037	5	60,359	22,009	6,117	1,204	14,365	5	43,720	7,496
3	Ranong	909		1	1,687		2,597	341		1	1,054		1,396	318
4	Trang					10,070	10,070							
5	Yala				32		32							
6	Pang-nga	7		100	12,000	65	12,772	7			175		162	67

Table 2.3.5 (5/5) AGRICULTURAL AREAS DAMAGED FLOOD IN 1995 AND 1996

Since November 18 - December 18, 1996

Item	Province	Flood area (Rai)						Damage area						No.of farmer
		Rice	Farm	Vegetable	Trees	Others	Total	Rice	Farm	Vegetable	Trees	Others	Total	(families)
14	Total	942,659	1,781	3,711	305,033	32,230	1,295,414	537,482	1,366	2,478	72,208	13,411	626,935	
2	NorthEast	65,953	201	300	1,066	0	67,520	50,289	176	300	1,066	0	51,831	
1	Bureerum	60,953	201	300	1,066	0	62,520	46,789	176	300	1,066	0	48,331	
2	Chaiyapoom	5,000	0	0	0	0	5,000	3,500	0	0	0	0	3,500	
	Central Part	9,112	0	12	0	0	9,124	7,363	0	12	0	0	7,375	
1	Angthong	9,112	0	12	0	0	9,124	7,363	0	12	0	0	7,375	
2	West	5,604	1,200	1,105	2,536	486	10,931	4,470	800	735	786	355	7,146	
1	Petchburi	5,604	1,000	735	1,581	0	8,920	4,470	800	735	786	0	6,791	
2	Prachubkireekan	0	200	370	955	466	2,011	0	0	0	0	355	355	
9	South	661,990	380	2,294	301,431	31,744	1,197,639	475,360	380	1,431	70,356	13,056	560,583	
1	Surattani	31,010	0	0	50,203	16,289	97,502	0	0	0	0	0	0	
2	Yala	0	0	37	336	175	548	0	0	37	51	175	263	
3	Chumporn	9,150	0	0	4,500	2,650	16,300	9,150	0	0	2,250	2,650	14,050	
4	Trang	6,700	0	847	40,559	150	50,256	0	0	0	0	0	0	
5	Pattalung	195,261	0	0	42,208	1,405	238,894	64,260	0	0	18,080	510	82,850	
6	Songkhla	124,225	380	1,410	8,275	0	134,290	76,173	380	1,394	2,616	0	80,763	
7	Pattanee	40,288	0	0	1,485	332	42,105	14,140	0	0	794	231	15,165	
8	Narativat	4,687	0	0	895	137	5,719	0	0	0	0	0	0	
9	Nakornsritamarat	448,649	0	0	152,970	10,606	612,225	311,637	0	0	46,365	9,490	367,492	

Table 2.3.6 SUMMARY OF RELIEF FOR FLOOD DAMAGED BY HURRICANE OLIS IN1995

Province	Damaged Area		Damage Cost	No.of farmer	No. of fish	No. of shrimp
	Amphur	Rai	Baht	Person	Fry	Fry
Machongsong	4	14.89	40,600	21	11,000	-
Kampaengpeth	4	244.9	380,100	234	292,000	-
Lumphun	4	502.25	343,000	276	494,000	-
Payao	5	1,299.01	17,352,396	1,709	2,054,000	-
Chiengrai	2	300.03	1,898,200	378	2,906,000	-
Nan	8	340.05	3,734,850	585	625,000	-
Nakornsawan	8	5,579.88	121,362,150	3,182	5,017,000	-
Petchaboon	5	2,086.05	3,509,000	1,759	2,331,000	-
Uthaithanee	7	1,028.22	12,495,900	1,151	1,358,000	-
Lampang	5	131.21	694,050	190	206,000	-
Phitsanuloke	8	2,972.80	26,621,970	2,751	4,822,000	-
Tak	5	353.66	752,700	270	397,000	-
Loey	12	1,741.55	10,651,120	1,546	2,002,000	-
Utaradit	9	2,272.18	9,160,350	1,491	2,233,000	-
Prae	7	609.49	4,758,200	695	854,000	-
Pichit	6	11,438.81	42,399,450	7,976	9,788,000	-
Chiengmai	7	700.38	3,576,500	717	909,000	-
Sukhothai	6	3,215.18	5,682,189	1,265	2,217,000	-
Udornthani	1	42	198,100	18	42,000	-
Patumtanee	7	6,897.67	29,404,981	2,065	4,244,000	-
Lopburi	9	4,634.61	36,933,921	2,068	3,879,000	-
Nontaburi	6	4,369.84	46,587,350	1,445	3,131,000	-
Chainat	6	751.46	11,738,210	616	746,000	-
Sinburi	6	1,084.16	19,465,650	746	1,055,000	-
Angthong	7	1,924.52	14,029,175	859	1,687,000	-
Ayuthaya	16	16,596.64	114,530,925	48,857	10,671,000	3,750,000
Saraburi	9	4,091.88	28,779,400	1,871	3,538,000	-
Nakornnayok	4	13,476	113,604,924	2,707	8,231,000	-
Supanburi	7	47,263.79	133,249,080	4,847	12,326,000	26,963,000
Mukdahan	3	572.1	1,189,700	453	627,000	-
Nongbualumpu	2	541.68	1,549,100	858	976,000	-
Ubonrachatani	4	151.48	498,400	65	142,000	-
Anmatcharoen	1	16.68	32,800	12	14,000	-
Sakolnakorn	4	453.5	1,224,000	310	454,000	-
Kalasin	5	1,050.92	1,090,750	610	1,098,000	-
Konkaeng	16	4,544.03	24,015,740	3,760	5,021,660	-
Chaiyapum	15	6,979.63	30,442,505	5,754	7,293,000	-
Nakornpanom	7	6,630.25	18,126,090	3,975	6,042,000	-
Nakornrachsrima	12	4,562.78	14,604,990	3,115	3,993,000	-
Burirum	11	6,730.67	2,477,336	1,250	1,612,000	-
Mahasarakam	5	2,359.75	12,817,950	1,361	2,186,000	-
Roi Ad	6	3,355.83	3,133,520	890	2,320,000	-
Srisaket	8	1,237.58	5,902,200	490	359,000	-
Surin	10	545.05	2,380,490	615	701,000	-
Nongkay	8	7,390.24	6,794,000	2,591	5,372,000	-
Chanburi	1	776,000	0	-		-
Chasoengsao	10	15,892.00	165,865,697	1,594	5,249,000	-
Chonburi	6	4,263.48	20,431,350	396	2,834,000	-
Trad	3	533.29	1,731,070	150	572,000	-
Prachinburi	5	9,764.95	34,541,045	1,652	4,110,000	-
Rayong	6	1,096.74	12,138,250	662	696,000	-
Sakaew	6	1,096.74	12,138,250	662	696,000	-
Samutprakarn	5	106,481	222,455,160	3,868	723,000	-
Samutsongkarm	1	669	2,972,000	0		-
Samutsakorn	2	323.04	1,730,125	47	165,000	-
Kanchanaburi	7	458.45	1,927,090	278	420,000	-
Nakornpathom	7	28,027.21	220,190,300	2,784	7,745,000	19,303,000
Pachupkirekan	5	2,224	14,909,800	330	156,000	-
Petchburi	5	4,134.20	46,047,100	440	632,000	-
Ranong	3	77.88	601,550	169	63,000	-
Satul	2	41.09	1,584,872	86	23,000	-
Kabi	5	42.46	869,400	128	122,000	-
Yala	1	13.12	203,180	22	25,000	-
Ratchburi	6	1,819.50	17,973,650	186	405,000	2,274,000
Nakornsritammarach	20	7,350.67	148,457,485	5,536	3,885,000	-
Trang	7	983.23	8,229,800	1,801	1,605,000	-
Chumporn	8	1,786.03	41,835,000	2,601	1,311,000	-
Pang-nga	3	373.02	1,015,000	15	47,000	-
Songkhla	12	1,764.72	33,758,826	1,853	1,301,000	-
Surattanee	15	3,823.91	54,695,793	2,138	1,725,000	1,169,000
Pattalung	6	1,657.13	6,022,789	2,190	1,451,000	-
Total	464	377,160.55	2,007,299,644	103,952	172,553,000	53,489,000

Table 3.1.1 QUANTITY OF PRIVATE AND AGRICULTURAL SECTORS

REGION	HOUSES (No)	COMMERCIAL (No	INDUSTRAL (No)	AGRICULTURAL(ha)
PHICHIT	96,277	2,248	723	331,892
KAMPAENG PHET	181	0	0	69
UTTARADIT	67,752	5,361	876	102,621
PHETCHABUN	31	3,853	1,763	1,349
SUKHOTHAI	108,281	6,324	1,209	223,857
PHITSANULOK	125,591	9,212	1,761	252,767
UTHAI THANI	11,295	3,298	418	27,128
NAKHON SAWAN	132,981	4,560	1,271	312,448
LOPBURI	76,007	3,820	511	92,744
SARABURI	69,535	13,149	843	109,510
CHAINAT	72,799	6,278	314	143,969
AYUTHYA	164,877	3,948	844	241,476
SINGBURI	49,274	4,375	306	76,562
ANG THONG	61,702	3,992	256	100,002
SUPHANBURI	157,444	12,891	998	314,350
NAKHON NAYOK	11,476	0	0	24,315
NONTHABURI	164,572	8,040	1,244	50,078
PATHUM THANI	181,041	5,702	1,531	68,878
SAMUT PRAKARN	247,389	17,608	4,028	19,049
SAMUT SAKHON	94,167	5,083	2,232	45,391
RATCHABURI	25,361	0	0	6,664
SAMUT SONGKHAM	21,553	0	0	2,447
CHACHOENGSAO	63,049	0	0	86,230
NAKHON PATHOM	167,657	2,861	1,746	125,186
BANGKOK	1,579,585	76,583	1,241	54,219
UPPER.C	398,113	26,998	6,332	912,554
NAKHONS.A	144,276	7,858	1,689	339,576
UPDELTA	663,114	48,453	4,072	1,102,928
LOWERDELTA	2,544,374	115,877	12,022	458,141
WHOLE AREA ①	3,749,877	199,186	24,115	2,813,197
①－BANGKOK	2,170,292	122,603	22,874	2,355,056

Table 3.1.2 WHOLE ASSETS VALUE IN THE STUDY AREA

(mil baht)

REGION	HOUSES	COMMERCIAL	INDUSTRIAL	AGRICULTURAL	TOTAL
PHICHIT	30,135	23,897	43,301	4,491	101,824
KAMPAENG PHET	57	0	0	1	57
UTTARADIT	21,206	56,986	52,439	1,580	132,211
PHETCHABUN	10	40,961	105,615	12	146,598
SUKHOTHAI	33,892	67,219	72,418	2,791	176,320
PHITSANULOK	39,310	97,919	105,506	3,720	246,455
UTHAI THANI	3,535	35,057	25,035	752	64,379
NAKHON SAWAN	41,623	48,474	76,171	3,478	169,746
LOPBURI	23,790	40,601	30,620	1,514	96,525
SARABURI	21,764	139,765	50,498	2,184	214,212
CHAINAT	22,786	66,728	18,804	3,033	111,350
AYUTHYA	51,607	41,962	36,970	3,257	133,795
SINGBURI	15,423	46,506	18,366	1,187	81,481
ANG THONG	19,313	42,438	15,360	1,353	78,463
SUPHANBURI	49,280	137,028	59,746	5,006	251,060
NAKHON NAYOK	3,592	0	0	551	4,143
NONTHABURI	178,561	102,551	99,272	1,435	381,818
PATHUM THANI	196,429	72,727	122,203	1,202	392,562
SAMUT PRAKARN	268,417	224,589	321,513	454	814,973
SAMUT SAKHON	102,171	68,397	164,800	2,310	337,679
RATCHABURI	7,938	0	0	339	8,277
SAMUT SONGKHAM	6,746	0	0	125	6,871
CHACHOENGSAO	19,734	0	0	1,564	21,298
NAKHON PATHOM	52,477	30,411	104,550	2,738	190,176
BANGKOK	1,713,850	976,777	99,017	1,346	2,790,990
UPPER.C	124,609	286,982	379,280	12,594	803,465
NAKHONS.A	45,158	83,531	101,206	4,230	234,125
UPDELTA	207,555	515,028	230,363	18,084	971,030
LOWERDELTA	2,546,323	1,475,452	911,356	11,514	4,944,644
WHOLE AREA ①	2,923,646	2,360,933	1,622,204	46,422	6,953,264
①－BANGKOK	832,475	1,384,216	1,523,187	45,076	4,162,274

Table 3.2.1 VALUE OF ASSETS

(Household) thousand Baht

	avarage/ building	average/ assets
Whole Kingdom	228	85
Bangkok Metro	674	211

Source: NSO (1994)

(Commerce) thousand Baht

	avarage/ building	average/ assets
Whole Kingdom/ Small	1,218	569
Whole Kingdom/ Large	7,829	5,999
Bangkok Metro/ Small	1,540	687
Bangkok Metro/ Large	1,540	8,127

Source: NSO (1994); Iflation rate (1993-1998) of 1.361 has been applied

(Industry) thousand Baht

	avarage/ building	average/ assets
Whole Kingdom/ Small	4,088	5,495
Whole Kingdom/ Large	24,550	75,288
Bangkok Metro/ Small	7,394	9,516
Bangkok Metro/ Large	27,158	91,888

Source: NSO (1992); Inflation rate (1991-1998) of 1.463 has been applied

(Other Establishments) thousand Baht

	avarage/ building	average/ assets
Whole Kingdom	105,403	141,689
Bangkok Metro	89,649	120,512

NOTE 1: All values are in 1998 Price Level

NOTE 2: 'Whole kingdom' does not include 'Bangkok Metro'.

NOTE 3: 'Bangkok Metro' is the area of Bangkok, Nonthaburi, Pathumthani, Samutprakan and Samutsakon.

NOTE 4: Definition of 'Small' and 'Large' group follows that in NSO's reports concerned.

NOTE 5: Asset values of other establishments are averages in the interview result.

NOTE 6: Conversion Rate to economic value is set at 0.96

Table 3.2.2 FLOOD DAMAGE RATE AND FARM GATE PIECE OF AGRICULTURAL PRODUCTS

(1) Flood Damage Rate

Flood Damage Rate of Rice (Values are for inundation of 7 days or more) Unit: %

Variety	Inundation Depth (m)						
	x < 0.3	0.3 < x < 0.5	0.5 < x < 1.0	1.0 < x < 1.5	1.5 < x		
High Yielding Variety (HYV)	0	50	71	100	100		
Traditional Variety	0	0	51	71	100		
Deep Water Rice	0	0	51	71	100		
	Inundation Depth (m)						
	x < 1.0	1.0 < x < 1.5	1.5 < x < 2.0	2.0 < x < 2.5	2.5 < x < 3.0	3.0 < x < 3.5	3.5 < x
Floating Rice	0	6	18	30	42	54	60

Flood Damage Rate of Other Crops Unit: %

Variety	Inundation Depth (m)			Note
	x < 0.5	0.5 < x < 1.0	1.0 < x	
Field Crops	100	100	100	maize, soy, bean, peanut, sugarcane
Vegetables	100	100	100	other plants except field crops and fruits
Fruits	25	28	50	

Source: Flood miligation manual (Ministray of Construction, Japan)

(2) Economic Farm Gate Price in 1998 Price Level

Rice Unit: Baht/ha

Variety	Price
High Yielding Variety (HYV)	16,400
Traditional Variety	8,600
Deep Water Rice	13,000
Floating Rice	8,600

Other Crops Unit: Baht/ha

Group	Price	Note
Field Crops	9,000	maize, soy, bean, peanut, sugarcane
Vegetables	64,200	other plants except field crops and fruits
Fruits	50,900	

Source: Kok Ing Nan Water Diversion Projects (JICA, 1997)
Agricultural Statistics of Thailand (1994/1995)
Farm Price Index (Bank of Thailand, 1997)
Price Index 1997/1995 of 172.75/166.97 has been applied

Kok Ing Nan Water Diversion Projects (JICA, 1997)
Agricultural Statistics of Thailand (1994/1995)
Farm Price Index (Bank of Thailand, 1997)
Price Index 1997/1995 of 172.75/166.97 has been applied

Table 3.4.1 ESTIMATION RESULTS OF REPRESENTATIVE FLOODS

1983 (mil. Baht)

RIGION	HOUSES	COMMERCE	INDUSTRIAL	AGRICULTURE	PUBULIC	OTHERS	TOTAL
UPPER CENTRAL PLAIN	774	2570	3642	750	675	310	8720
NAKHON SAWAN	104	375	963	84	75	35	1635
HIGHER DELTA	1402	3435	8647	818	736	338	15375
LOWER DELTA	23921	9764	10333	884	796	366	46065
TOTAL	26201	16143	23584	253	2283	1048	71796
TOTAL (%)	36	22	33	4	3	1	100

1995 (mil. Baht)

RIGION	HOUSES	COMMERCE	INDUSTRIAL	AGRICULTURE	PUBULIC	OTHERS	TOTAL
UPPER CENTRAL PLAIN	1903	4050	5439	959	670	295	13316
NAKHON SAWAN	550	1194	2377	186	130	57	4495
HIGHER DELTA	2214	7044	8968	1595	1114	491	21428
LOWER DELTA	5524	7279	19234	721	504	222	33484
TOTAL	10192	19567	36018	3461	2418	1066	72723
TOTAL (%)	14	27	50	5	3	1	100

1996 (mil. Baht)

RIGION	HOUSES	COMMERCE	INDUSTRIAL	AGRICULTURE	PUBULIC	OTHERS	TOTAL
UPPER CENTRAL PLAIN	1026	1704	2491	526	324	160	6231
NAKHON SAWAN	205	502	1089	104	64	32	1995
HIGHER DELTA	1131	2964	4107	992	610	301	8227
LOWER DELTA	1590	3063	8808	241	148	73	13924
TOTAL	3953	8233	16494	1864	1146	565	32256
TOTAL (%)	12	26	51	6	4	2	100

Table 4.2.1 CONVERSION RATES OF ASSET VALUE

Assets	from 1998 to 2005		from 1998 to 2018	
	Bangkok	Other Areas	Bangkok	Other Areas
General	1.54	1.12	3.75	1.81
Agriculture	1.19	1.19	1.64	1.64

Table 4.2.2 RESULT OF CALCULATION IN THE 45 FLOODS

(mil. Baht)

Year	Bangkok	Others	Total	Year	Bangkok	Others	Total
1952	0	18,049	18,049	1975	0	31,141	31,141
1953	0	14,115	14,115	1976	0	22,635	22,635
1954	0	26,280	26,280	1977	0	13,550	13,550
1955	0	15,979	15,979	1978	51,000	31,445	82,445
1956	0	26,158	26,158	1979	0	8,422	8,422
1957	0	29,022	29,022	1980	0	33,483	33,483
1958	0	13,513	13,513	1981	0	14,296	14,296
1959	0	28,049	28,049	1982	0	9,992	9,992
1960	0	14,560	14,560	1983	20,000	39,529	59,529
1961	0	21,586	21,586	1984	0	11,385	11,385
1962	0	30,581	30,581	1985	0	17,405	17,405
1963	0	22,202	22,202	1986	0	9,132	9,132
1964	0	30,326	30,326	1987	0	18,131	18,131
1965	0	11,234	11,234	1988	0	16,396	16,396
1966	0	17,340	17,340	1989	0	10,680	10,680
1967	0	17,425	17,425	1990	0	13,610	13,610
1968	0	7,357	7,357	1991	0	9,309	9,309
1969	0	19,368	19,368	1992	0	13,298	13,298
1970	0	28,185	28,185	1993	0	7,948	7,948
1971	0	17,396	17,396	1994	0	19,301	19,301
1972	0	13,431	13,431	1995	68,000	53,535	121,535
1973	0	22,500	22,500	1996	4,000	33,854	37,854
1974	0	18,614	18,614	AVERAGE	3,178	20,039	23,217

Table 4.4.1 Benefit for Each Project

	No	Project Name	Condition						$(D_{wop}-D_{wp})/D_{wop}$		Benefit (mil. Baht)		
			Dam Operation	Diversion	Distribution System	River Improvement	Heightning Ring	Drainage	Bangkok	Other Areas	Bangkok	Other Areas	Total
Independent Project	1	Dam Operation Rule	14600 mil m3	-	-	-	-	-	0.33	0.02	1,379	401	1,780
	2	River Improvement From Chainat to Pathum Thani	-	-	-	10 yr (Chainat to Pathum Thani)	-	-	0.00	0.01	0	220	220
			-	-	-	25 yr (Chainat to Pathum Thani)	-	-	0.00	0.02	0	420	420
	3	Ayuthaya-East-Sea Diversion	-	1100 m3/s	-	-	-	-	1.00	0.05	4,200	1,043	5,243
			-	800 m3/s	-	-	-	-	1.00	0.05	4,200	994	5,194
	4	Distribution System	-	-	5600Km2	-	-	-	0.00	0.01	0	140	140
	5	Heightning Bangkok	-	-	-	-	H	-	1.00	0.00	4,200	0	4,200
	6	Drainage B-1	-	-	-	-	-	B1	0.00	0.08	0	1,637	1,637
Combination Project	1	alternative 1	10400 mil m3	-	5600Km2	10 yr (Chainat to Pathum Thani)	-	B1	0.82	0.08	*3451	1,638	5,089
	2	alternative2-1	10400 mil m3	-	5600Km2	10 yr (Chainat to Pathum Thani)	H	B1	1.06	0.08	4,452	1,638	6,090
	3	alternative2-2	10400 mil m3	1100 m3/s	5600km2	25 yr (Chainat to Pathum Thani)	-	B1	1.06	0.09	4,452	1,848	6,300

Table 5.2.1 (1/2) FLOOD DAMAGE AMOUNT WITH AND WITHOUT MODIFICATION OF DAM OPERATION

Damage Amount

(1) Without Modification of Dam Operation (mil.baht)

YEAR	BMA			Others			Grand Total
	General	Agriculture	Total	General	Agriculture	Total	
1964	0	0	0	20,752	4,130	24,882	24,882
1965	0	0	0	6,909	1,375	8,284	8,284
1966	0	0	0	9,722	1,935	11,657	11,657
1967	0	0	0	9,950	1,980	11,930	11,930
1968	0	0	0	3,879	772	4,652	4,652
1969	0	0	0	10,272	2,045	12,317	12,317
1970	0	0	0	18,530	3,688	22,219	22,219
1971	0	0	0	9,592	1,909	11,502	11,502
1972*	0	0	0	7,631	1,519	9,150	9,150
1973	0	0	0	12,033	2,395	14,428	14,428
1974	0	0	0	9,961	1,983	11,944	11,944
1975	0	0	0	23,329	4,643	27,972	27,972
1976	0	0	0	12,068	2,402	14,469	14,469
1977	0	0	0	7,620	1,517	9,137	9,137
1978*	22,763	23	22,786	22,980	4,574	27,553	50,340
1979*	0	0	0	4,215	839	5,054	5,054
1980	0	0	0	21,916	4,362	26,278	26,278
1981	0	0	0	8,016	1,596	9,611	9,611
1982	0	0	0	6,487	1,291	7,778	7,778
1983*	4,108	4	4,112	19,061	3,794	22,855	26,967
1984*	0	0	0	6,146	1,223	7,369	7,369
1985*	0	0	0	8,755	1,743	10,498	10,498
1986	0	0	0	5,778	1,150	6,928	6,928
1987*	0	0	0	10,024	1,995	12,020	12,020
1988	0	0	0	9,449	1,881	11,330	11,330
1989	0	0	0	5,312	1,057	6,370	6,370
1990	0	0	0	7,865	1,565	9,430	9,430
1991	0	0	0	5,155	1,026	6,181	6,181
1992*	0	0	0	6,191	1,232	7,423	7,423
1993	0	0	0	4,524	900	5,424	5,424
1994	0	0	0	13,363	2,660	16,023	16,023
1995*	43,418	43	43,462	27,749	5,523	33,272	76,734
1996*	0	0	0	15,725	3,130	18,854	18,854
Total of 33 floods	70,290	70	70,360	370,959	73,836	444,795	515,155
Total of Representative 10 Floods	70,290	70	70,360	128,477	25,572	154,049	224,409
Average Annual Damge**	2,130	2	2,132	11,241	2,237	13,479	15,611
Average of 10 Floods	7,029	7	7,036	12,848	2,557	15,405	22,441

*: Representative 10 Floods

**: Average of 33 Floods

Note: Flood damage amounts are under the future basin condition in 2005.

(2) With Modification of Bhumibol Dam Operation (mil.baht)

YEAR	BMA			Others			Grand Total
	General	Agriculture	Total	General	Agriculture	Total	
1972	0	0	0	7,534	1,500	9,033	9,033
1978	22,349	22	22,372	22,764	4,531	27,295	49,667
1979	0	0	0	4,171	830	5,001	5,001
1983	4,108	4	4,112	19,060	3,794	22,854	26,967
1984	0	0	0	6,141	1,222	7,364	7,364
1985	0	0	0	8,755	1,743	10,498	10,498
1987	0	0	0	10,013	1,993	12,007	12,007
1992	0	0	0	6,191	1,232	7,423	7,423
1995	43,016	43	43,059	27,709	5,515	33,225	76,284
1996	0	0	0	15,724	3,130	18,854	18,854
Total of 10 floods	69,474	70	69,544	128,063	25,490	153,553	223,097
Average of 10 floods	6,947	7	6,954	12,806	2,549	15,355	22,310
Average Damage Reduction in 10 floods	816	1	817	414	82	496	1,313
Damage Reduction Rate (%)	1.2	1.2	1.2	0.3	0.3	0.3	1
Average Annual Damage Reductio	25	0	25	36	7	43	68

(3) With Modification of Pasak Dam Operation (mil.baht)

YEAR	BMA			Others			Grand Total
	General	Agriculture	Total	General	Agriculture	Total	
1972	0	0	0	7,623	1,517	9,140	9,140
1978	21,522	22	21,543	22,013	4,381	26,394	47,937
1979	0	0	0	4,215	839	5,054	5,054
1983	4,108	4	4,112	18,813	3,745	22,557	26,670
1984	0	0	0	6,135	1,221	7,356	7,356
1985	0	0	0	8,665	1,725	10,390	10,390
1987	0	0	0	9,706	1,932	11,638	11,638
1992	0	0	0	5,952	1,185	7,137	7,137
1995	40,202	40	40,243	26,119	5,199	31,318	71,560
1996	0	0	0	14,737	2,933	17,670	17,670
Total	65,832	66	65,898	123,978	24,677	148,655	214,553
Average	6,583	7	6,590	12,398	2,468	14,865	21,455
Average Damage Reduction in 10 floods	4,458	4	4,462	4,499	895	5,394	9,856
Damage Reduction Rate (%)	6.3	6.3	6.3	3.5	3.5	3.5	4.4
Average Annual Damage Reductio	135	0	135	394	78	472	607

(4) With Modification of Sirikit Dam Operation (mil.baht)

YEAR	BMA			Others			Grand Total
	General	Agriculture	Total	General	Agriculture	Total	
1972	0	0	0	7,631	1,519	9,150	9,150
1978	22,185	22	22,207	22,770	4,532	27,302	49,509
1979	0	0	0	4,215	839	5,054	5,054
1983	4,108	4	4,112	19,058	3,793	22,851	26,963
1984	0	0	0	6,167	1,227	7,394	7,394
1985	0	0	0	8,755	1,743	10,498	10,498
1987	0	0	0	10,022	1,995	12,017	12,017
1992	0	0	0	6,154	1,225	7,378	7,378
1995	36,564	37	36,601	25,401	5,056	30,457	67,058
1996	0	0	0	15,723	3,130	18,853	18,853
Total	62,858	63	62,921	125,895	25,058	150,954	213,875
Average	6,286	6	6,292	12,590	2,506	15,095	21,387
Average Damage Reduction in 10 floods	7,432	7	7,440	2,581	514	3,095	10,535
Damage Reduction Rate (%)	10.6	10.6	10.6	2.0	2.0	2.0	4.7
Average Annual Damage Reductio	225	0	225	226	45	271	496

Table 5.2.1 (2/2) FLOOD DAMAGE AMOUNT WITH AND WITHOUT MODIFICATION OF DAM OPERATION

(1) Damage Amount

(a) Without Modification of Dam Operation (mil.baht)

YEAR	BMA			Others		
	General	Agriculture	Total	General	Agriculture	Total
1964	0	0	0	20,752	4,130	24,882
1965	0	0	0	6,909	1,375	8,284
1966	0	0	0	9,722	1,935	11,657
1967	0	0	0	9,950	1,980	11,930
1968	0	0	0	3,879	772	4,652
1969	0	0	0	10,272	2,045	12,317
1970	0	0	0	18,530	3,688	22,219
1971	0	0	0	9,592	1,909	11,502
1972	0	0	0	7,631	1,519	9,150
1973	0	0	0	12,033	2,395	14,428
1974	0	0	0	9,961	1,983	11,944
1975	0	0	0	23,329	4,643	27,972
1976	0	0	0	12,068	2,402	14,469
1977	0	0	0	7,620	1,517	9,137
1978	22,763	23	22,786	22,980	4,574	27,553
1979	0	0	0	4,215	839	5,054
1980	0	0	0	21,916	4,362	26,278
1981	0	0	0	8,016	1,596	9,611
1982	0	0	0	6,487	1,291	7,778
1983	4,108	4	4,112	19,061	3,794	22,855
1984	0	0	0	6,146	1,223	7,369
1985	0	0	0	8,755	1,743	10,498
1986	0	0	0	5,778	1,150	6,928
1987	0	0	0	10,024	1,995	12,020
1988	0	0	0	9,449	1,881	11,330
1989	0	0	0	5,312	1,057	6,370
1990	0	0	0	7,865	1,565	9,430
1991	0	0	0	5,155	1,026	6,181
1992	0	0	0	6,191	1,232	7,423
1993	0	0	0	4,524	900	5,424
1994	0	0	0	13,363	2,660	16,023
1995	43,418	43	43,462	27,749	5,523	33,272
1996	0	0	0	15,725	3,130	18,854

(b) With Modification of the 3 Dams (mil.baht)

YEAR	BMA			Others		
	General	Agriculture	Total	General	Agriculture	Total
1964	0	0	0	19,302	3,842	23,144
1965	0	0	0	6,862	1,366	8,228
1966	0	0	0	9,375	1,866	11,241
1967	0	0	0	9,612	1,913	11,525
1968	0	0	0	3,810	758	4,569
1969	0	0	0	9,987	1,988	11,974
1970	0	0	0	15,439	3,073	18,512
1971	0	0	0	9,592	1,909	11,502
1972	0	0	0	7,524	1,498	9,021
1973	0	0	0	11,621	2,313	13,934
1974	0	0	0	9,859	1,962	11,821
1975	0	0	0	18,369	3,656	22,025
1976	0	0	0	11,646	2,318	13,964
1977	0	0	0	7,409	1,475	8,884
1978	21,363	21	21,385	21,743	4,328	26,071
1979	0	0	0	4,183	833	5,016
1980	0	0	0	20,724	4,125	24,849
1981	0	0	0	8,016	1,596	9,611
1982	0	0	0	6,466	1,287	7,753
1983	4,108	4	4,112	18,837	3,749	22,587
1984	0	0	0	6,146	1,223	7,369
1985	0	0	0	8,666	1,725	10,390
1986	0	0	0	5,778	1,150	6,928
1987	0	0	0	9,703	1,931	11,634
1988	0	0	0	8,974	1,786	10,761
1989	0	0	0	5,248	1,044	6,292
1990	0	0	0	7,578	1,508	9,086
1991	0	0	0	5,155	1,026	6,181
1992	0	0	0	5,976	1,189	7,165
1993	0	0	0	4,524	900	5,424
1994	0	0	0	12,451	2,478	14,930
1995	34,976	35	35,011	21,748	4,329	26,077
1996	0	0	0	14,752	2,936	17,688

(2) Damage Reduction Amount (mil.baht)

YEAR	BMA			Others			Grand Total
	General	Agriculture	Total	General	Agriculture	Total	
1964	0	0	0	1,450	289	1,738	1,738
1965	0	0	0	47	9	57	57
1966	0	0	0	347	69	416	416
1967	0	0	0	338	67	405	405
1968	0	0	0	69	14	83	83
1969	0	0	0	286	57	343	343
1970	0	0	0	3,091	615	3,706	3,706
1971	0	0	0	0	0	0	0
1972	0	0	0	108	21	129	129
1973	0	0	0	412	82	495	495
1974	0	0	0	103	20	123	123
1975	0	0	0	4,960	987	5,948	5,948
1976	0	0	0	422	84	506	506
1977	0	0	0	211	42	253	253
1978	1,400	1	1,401	1,237	246	1,483	2,884
1979	0	0	0	32	6	39	39
1980	0	0	0	1,192	237	1,429	1,429
1981	0	0	0	0	0	0	0
1982	0	0	0	21	4	25	25
1983	0	0	0	224	45	268	268
1984	0	0	0	0	0	0	0
1985	0	0	0	89	18	107	107
1986	0	0	0	0	0	0	0
1987	0	0	0	321	64	385	385
1988	0	0	0	475	95	570	570
1989	0	0	0	65	13	78	78
1990	0	0	0	287	57	344	344
1991	0	0	0	0	0	0	0
1992	0	0	0	215	43	258	258
1993	0	0	0	0	0	0	0
1994	0	0	0	912	182	1,094	1,094
1995	8,442	8	8,451	6,001	1,194	7,195	15,646
1996	0	0	0	973	194	1,166	1,166
Average Annual Damage Reduction in Future Basin Condition in 2005	298	0	299	724	144	868	1,166

Note : Damage amounts are under the future basin condition in 2005.

Table 5.3.1 FLOOD DAMAGE AMOUNT WITH AND WITHOUT RIVER IMPROVEMENT

(1) 1957 Flood (3-year Flood)

(a) Damage Amount (mil.baht)

Case	Area-1	Area-2	Area-3	Area-4	Area-5	Area-6	Area-7	Area-8	River Bank	Total of Protected	Total of Unprotected	Total
WOP	558	1,389	19	70	140	256	135	1,436	17	0	4,019	4,019
Case5-1	319	1,389	19	75	140	271	135	1,494	19	319	3,542	3,860
Case5-2	319	1,139	19	80	150	284	142	1,520	19	1,458	2,214	3,672
Csae5-3	319	1,139	19	80	150	284	142	1,520	19	1,477	2,195	3,672
Csae5-4	319	1,139	19	53	164	317	157	1,568	19	1,530	2,225	3,754
Case3	319	1,389	19	53	91	140	88	924	17	3,023	17	3,040

(b) Difference between WOP and Each Case (mil.baht)

Case	Area-1	Area-2	Area-3	Area-4	Area-5	Area-6	Area-7	Area-8	River Bank	Total of Protected	Total of Unprotected	Grand Total
Case5-1	239	0	0	-5	0	-15	0	-58	-2	239	-81	158
Case5-2	239	250	0	-10	-10	-28	-7	-84	-2	489	-142	347
Csae5-3	239	250	0	-10	-10	-28	-7	-84	-2	489	-142	347
Csae5-4	239	250	0	17	-24	-61	-22	-133	-2	506	-242	264
Case3	239	0	0	17	49	116	47	512	0	979	0	979

(2) 1996 Flood (5-year Flood)

(a) Damage Amount (mil.baht)

Case	Area-1	Area-2	Area-3	Area-4	Area-5	Area-6	Area-7	Area-8	River Bank	Total of Protected	Total of Unprotected	Total
WOP	768	428	5	56	79	351	163	591	40	0	2,481	2,481
Case5-1	50	438	38	138	83	364	174	677	47	50	1,959	2,008
Case5-2	50	325	40	142	83	379	174	679	47	375	1,544	1,919
Csae5-3	50	325	5	154	84	394	174	687	53	379	1,546	1,925
Csae5-4	50	325	5	43	96	424	184	833	50	423	1,587	2,010

(b) Difference between WOP andEach Case (mil.baht)

Case	Area-1	Area-2	Area-3	Area-4	Area-5	Area-6	Area-7	Area-8	River Bank	Total of Protected	Total of Unprotected	Total
Case5-1	718	-10	-33	-82	-4	-13	-11	-86	-7	718	-246	472
Case5-2	718	103	-35	-86	-4	-28	-11	-88	-7	821	-259	562
Csae5-3	718	103	0	-98	-5	-43	-11	-96	-13	821	-265	556
Csae5-4	718	102	0	13	-17	-73	-20	-242	-10	833	-363	471

WOP : without project

Protected Area Unprotected Area

Note: Flood damage is estimated under the future basin condition in 2005.

Table 5.3.2 (1/2) ESTIMATION OF AVERAGE ANNUAL DAMAGE REDUCTION

(1)Damage Reduction in Total Area

(1) Case 3 (3-yr Improvement)

Return Period (year)	Flood Damage (mil. baht) w/o Project	Flood Damage (mil. baht) w/ Project	Damage Reduction (mil. baht)	Mean Damage Reduction (mil. Baht)	Probability	Expected Damage Reduction (mil. baht)
1.3	-	-	0			
				490	0.436	213
3	4,019	3,040	979			
				-	-	-
5	-	-	-			

Total (Average Annual Benefit) : 213

(2) Case 5-1 (Area1)

Return Period (year)	Flood Damage (mil. baht) w/o Project	Flood Damage (mil. baht) w/ Project	Damage Reduction (mil. baht)	Mean Damage Reduction (mil. Baht)	Probability	Expected Damage Reduction (mil. baht)
1.3	-	-	0			
				79	0.436	35
3	4,019	3,860	158			
				315	0.133	42
5	2,481	2,008	472			

Total (Average Annual Benefit) : 77

(3) Case 5-2 (Area1to2)

Return Period (year)	Flood Damage (mil. baht) w/o Project	Flood Damage (mil. baht) w/ Project	Damage Reduction (mil. baht)	Mean Damage Reduction (mil. Baht)	Probability	Expected Damage Reduction (mil. baht)
1.3	0	0	0			
				173	0.436	76
3	4,019	3,672	347			
		-		454	0.133	61
5	2,481	1,919	562			

Total (Average Annual Benefit) : 136

(4) Case 5-3 (Area1to3)

Return Period (year)	Flood Damage (mil. baht) w/o Project	Flood Damage (mil. baht) w/ Project	Damage Reduction (mil. baht)	Mean Damage Reduction (mil. Baht)	Probability	Expected Damage Reduction (mil. baht)
1.3	-	-	0			
				174	0.436	76
3	4,019	3,672	347			
				451	0.133	60
5	2,481	1,925	556			

Total (Average Annual Benefit) : 136

(5) Case 5-4 (Area1to4)

Return Period (year)	Flood Damage (mil. baht) w/o Project	Flood Damage (mil. baht) w/ Project	Damage Reduction (mil. baht)	Mean Damage Reduction (mil. Baht)	Probability	Expected Damage Reduction (mil. baht)
1.3	-	-	0			
				132	0.436	58
3	4,019	3,754	264			
				367	0.133	49
5	2,481	2,010	471			

Total (Average Annual Benefit) : 107

Note: Flood damage reduction is under the future basin condition in 2005.

Table 5.3.2 (2/2) ESTIMATION OF AVERAGE ANNUAL DAMAGE REDUCTION

(2) Damage Increase in Unprotected Area

(1) Case 3 (3-yr Improvement)

Return Period (year)	Flood Damage (mil. baht) w/o Project	Flood Damage (mil. baht) w/ Project	Damage Reduction (mil. baht)	Mean Damage Reduction (mil. Baht)	Probability	Expected Damage Reduction (mil. baht)
1.3	-	-	0			
				0	0.436	0
3	17	17	0			
				-	-	-
5	-	-	-			

Total (Average Annual Benefit) : 0

(2) Case 5-1 (Area1)

Return Period (year)	Flood Damage (mil. baht) w/o Project	Flood Damage (mil. baht) w/ Project	Damage Reduction (mil. baht)	Mean Damage Reduction (mil. Baht)	Probability	Expected Damage Reduction (mil. baht)
1.3	-	-	0			
				-40	0.436	-18
3	3,461	3,542	-81			
				-163	0.133	-22
5	1,713	1,959	-246			

Total (Average Annual Benefit) : -39

(3) Case 5-2 (Area1to2)

Return Period (year)	Flood Damage (mil. baht) w/o Project	Flood Damage (mil. baht) w/ Project	Damage Reduction (mil. baht)	Mean Damage Reduction (mil. Baht)	Probability	Expected Damage Reduction (mil. baht)
1.3	-	-	0			
				-71	0.436	-31
3	2,072	2,214	-142			
				-200	0.133	-27
5	1,285	1,544	-259			

Total (Averge Annual Benefit) : -58

(4) Case 5-3 (Area1to3)

Return Period (year)	Flood Damage (mil. baht) w/o Project	Flood Damage (mil. baht) w/ Project	Damage Reduction (mil. baht)	Mean Damage Reduction (mil. Baht)	Probability	Expected Damage Reduction (mil. baht)
1.3	-	-	0			
				-71	0.436	-31
3	2,053	2,195	-142			
				-204	0.133	-27
5	1,280	1,546	-265			

Total (Average Annual Benefit) : -58

(5) Case 5-4 (Area1to4)

Return Period (year)	Flood Damage (mil. baht) w/o Project	Flood Damage (mil. baht) w/ Project	Damage Reduction (mil. baht)	Mean Damage Reduction (mil. Baht)	Probability	Expected Damage Reduction (mil. baht)
1.3	-	-	0			
				-121	0.436	-53
3	1,983	2,225	-242			
				-302	0.133	-40
5	1,225	1,587	-363			

Total (Average Annual Benefit) : -93

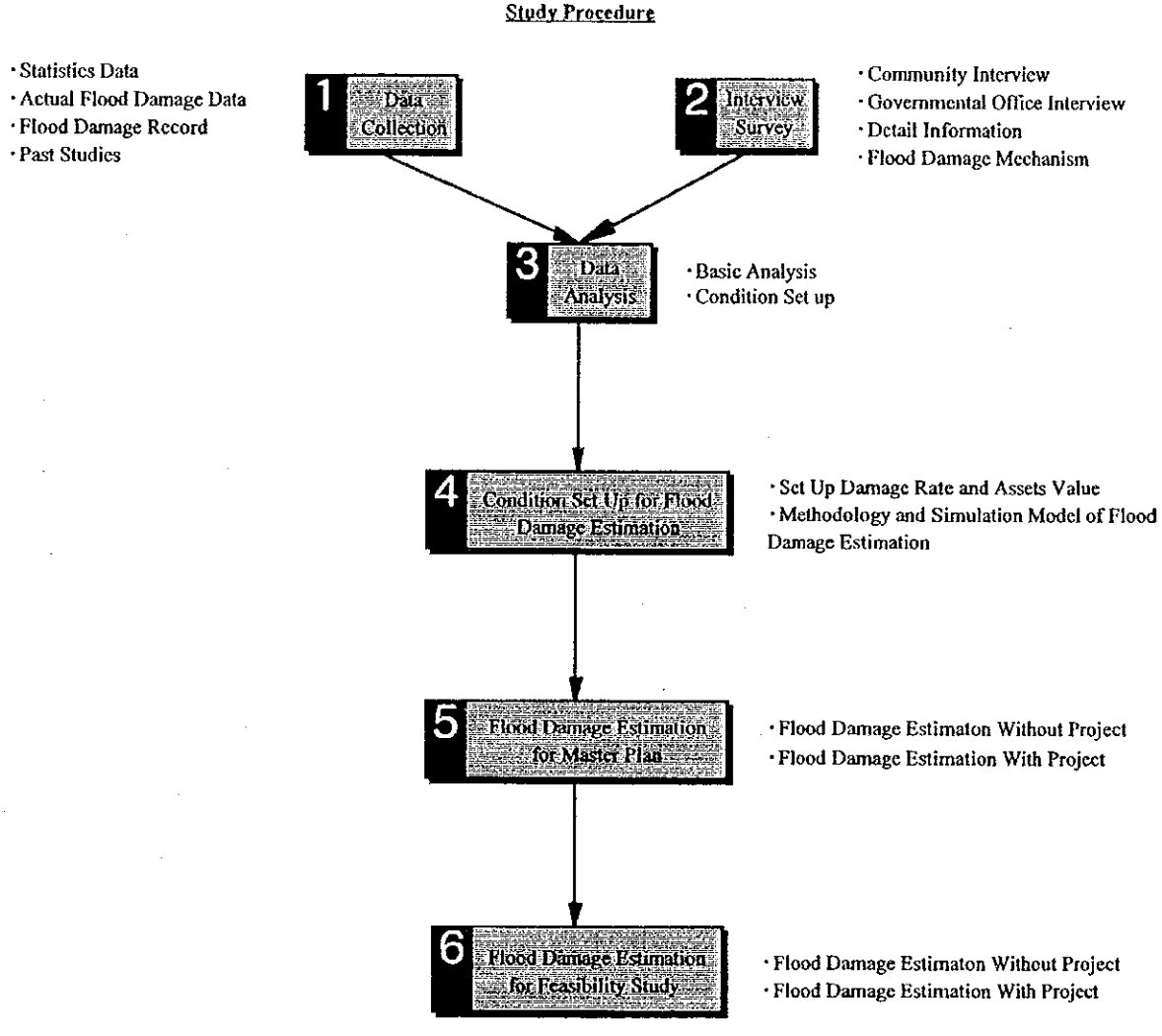
Note: Flood damage reduction is under the future basin condition in 2005.

Table 5.3.3 BENEFIT OF RIVER IMPROVEMENT

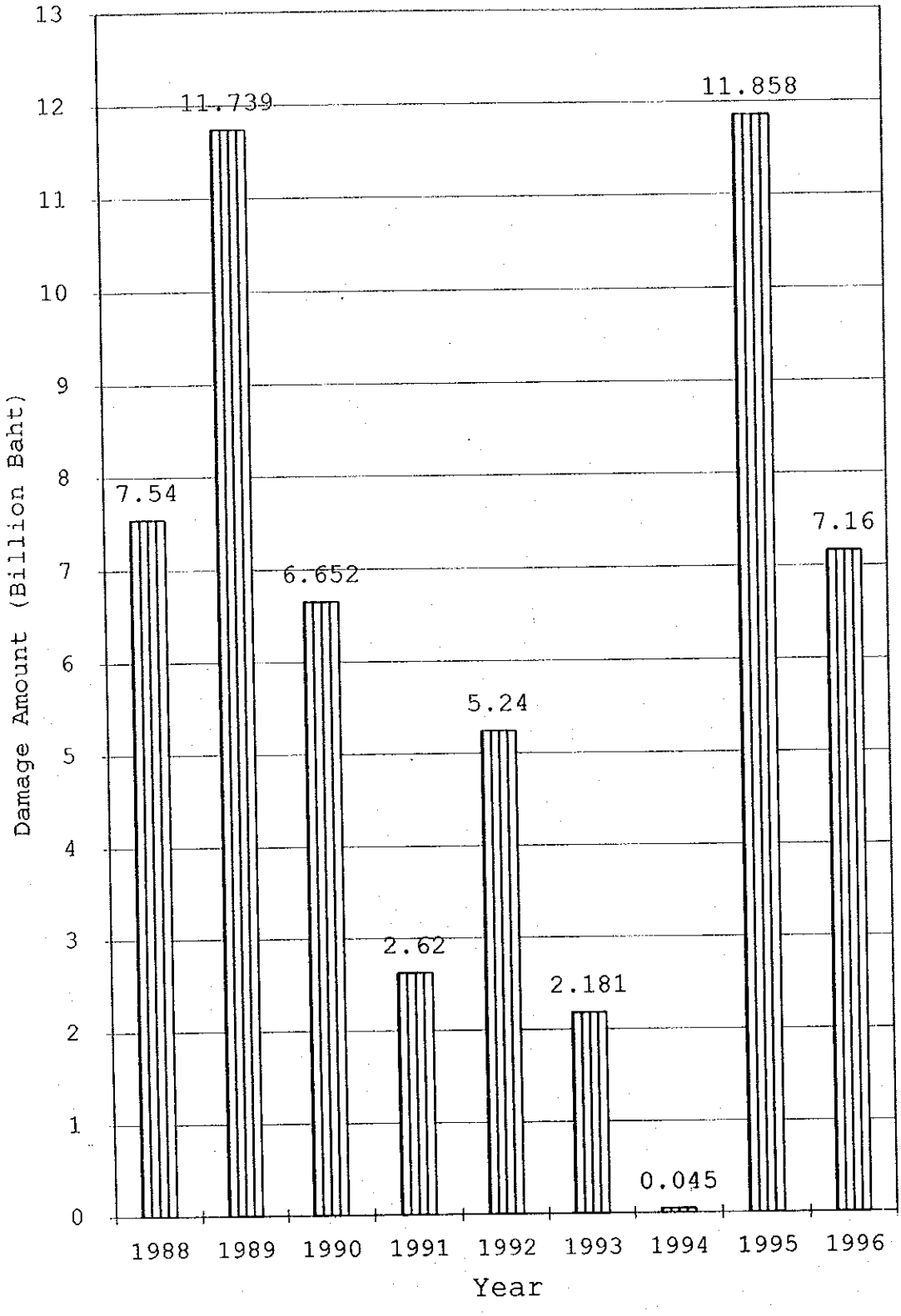
Case	Benefit (mil. Baht/year)								
	Protected Areas			Unprotected area			Total		
	General	Aguriculture	Total	General	Aguriculture	Total	General	Aguriculture	Total
Case5-1	97	19	116	-33	-6	-39	64	13	77
Case5-2	162	32	194	-48	-10	-58	113	23	136
Case5-3	162	32	194	-48	-10	-58	113	23	136
Case5-4	167	33	200	-78	-15	-93	89	18	107
Case3	178	35	213	0	0	0	178	35	213

Note: Benefits are under the future condition in 2005.

Figures



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAOPHRAYA RIVER BASIN	Fig.1.1.1 STUDY PROCEDURE
CTI ENGINEERING CO., LTD & INA CORPORATION	



(Source: Dept. of Local Administration ('88 - '96)

STUDY ON ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAOPHRAYA RIVER BASIN CTI ENGINEERING CO., LTD & INA CORPORATION	Fig.2.1.1 RECORDED ANNUAL FLOOD DAMAGE ON INFRASTRUCTURE

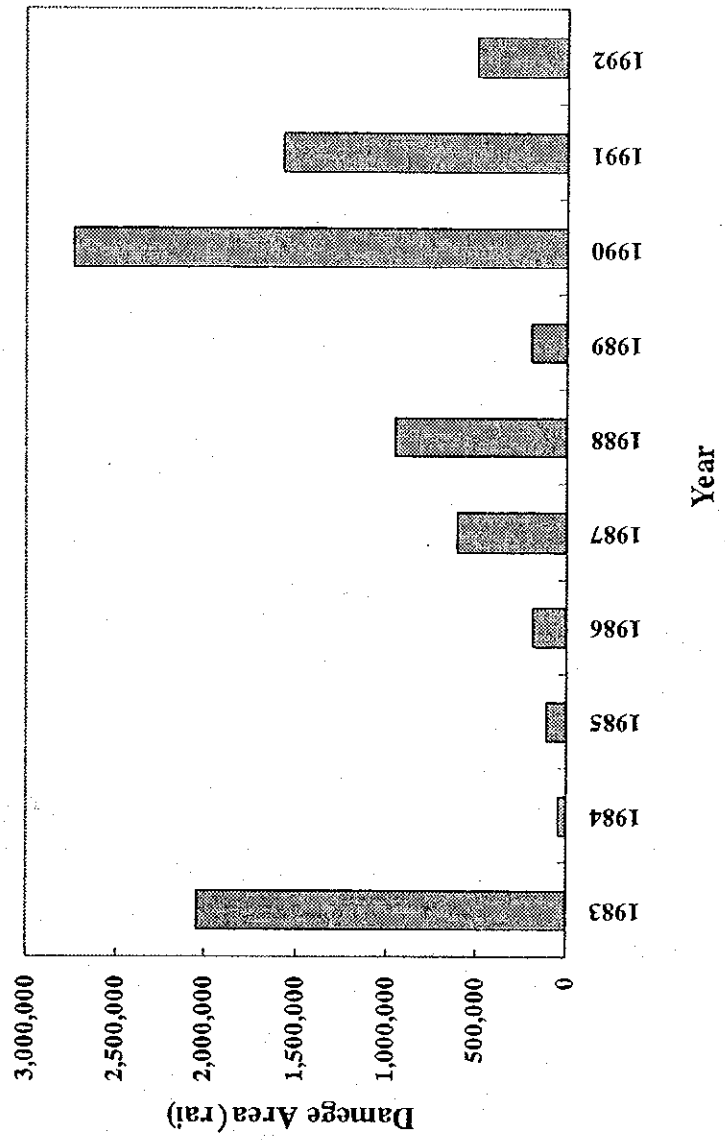
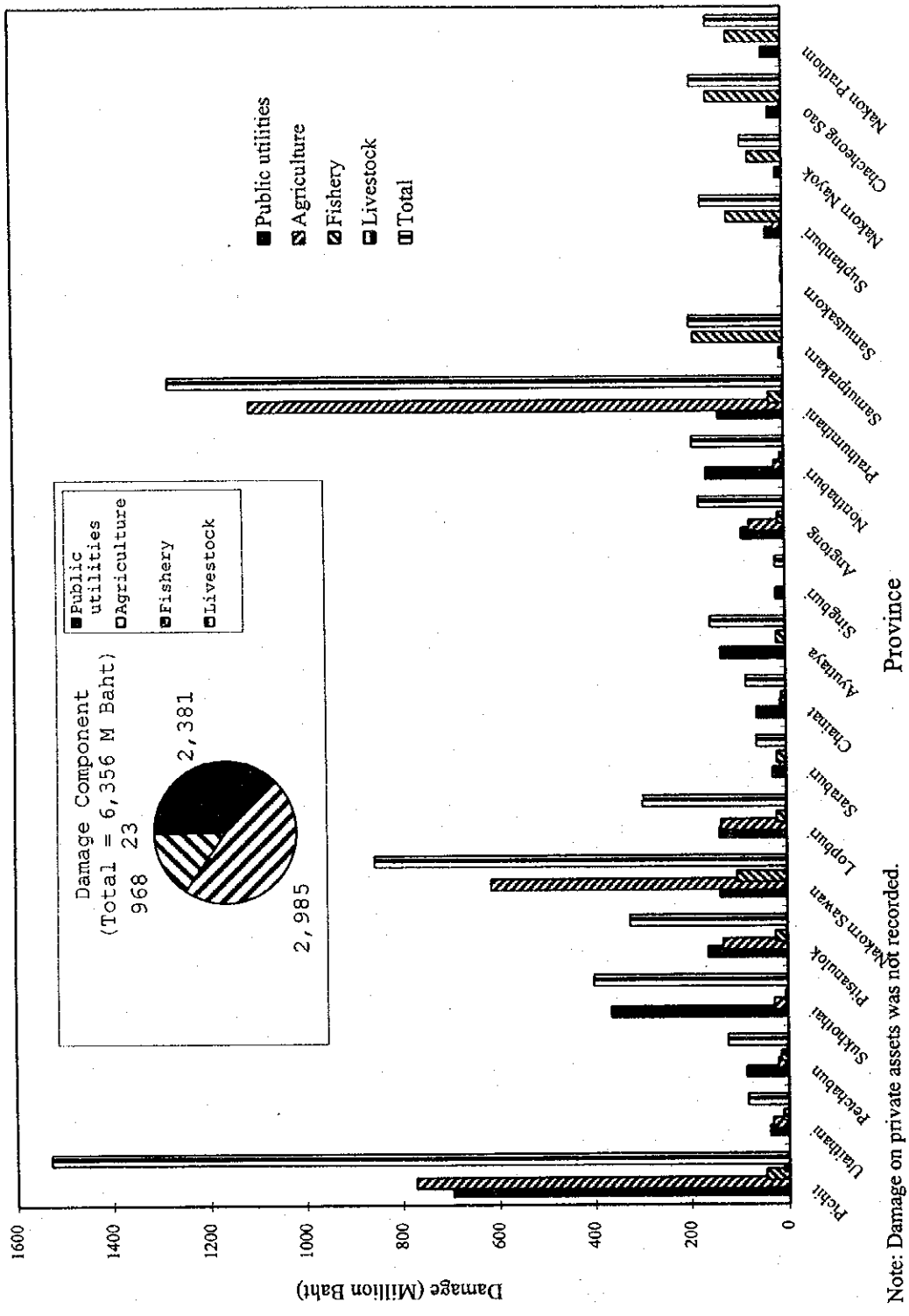


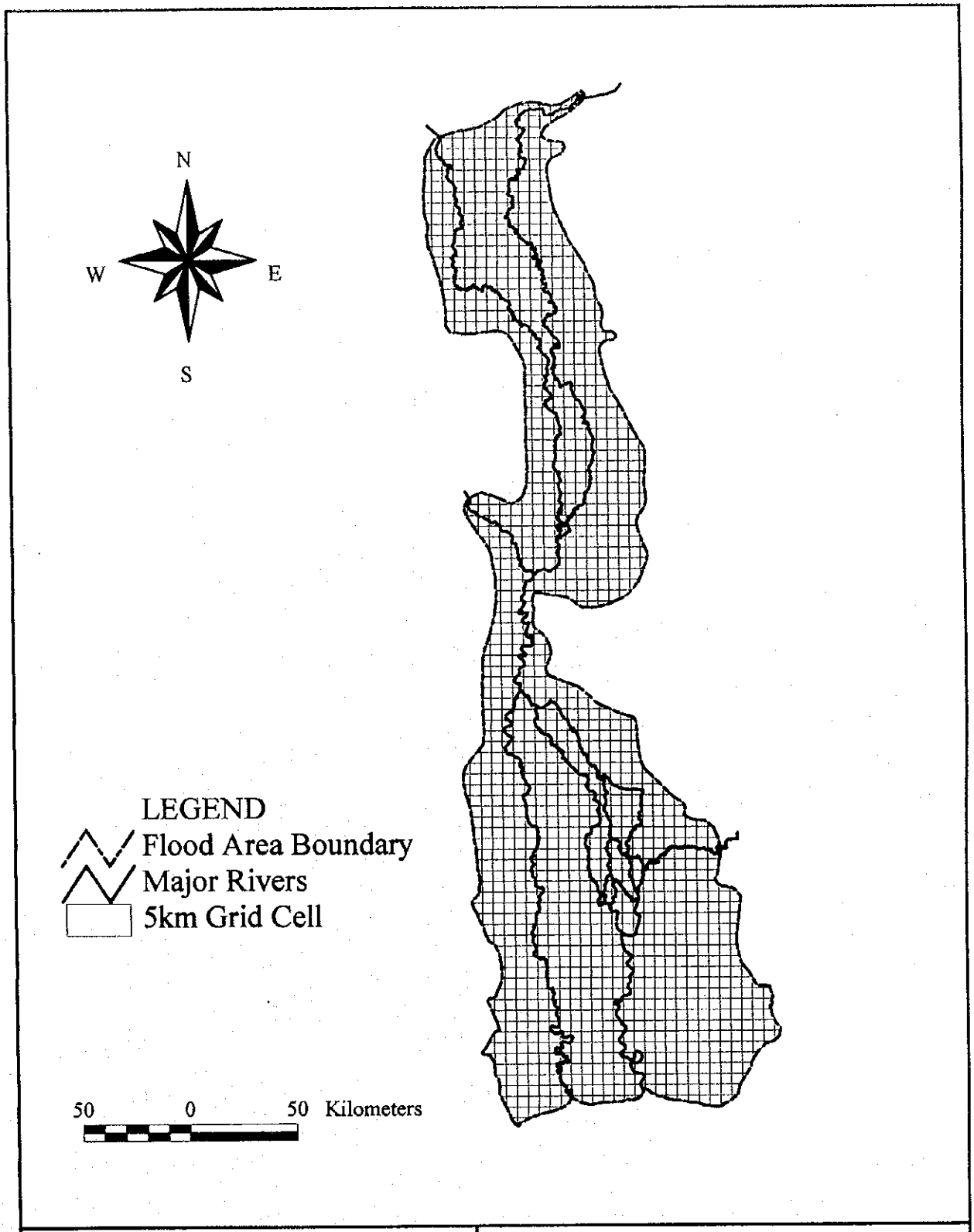
Fig .2.1.2 AGRICULTURAL DAMAGE DUE TO DROUGHT

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAOPHRAYA RIVER BASIN	Fig.2.1.2 AGRICULTURAL DAMAGE DUE TO DROUGHT
CTI ENGINEERING CO., LTD & INA CORPORATION	



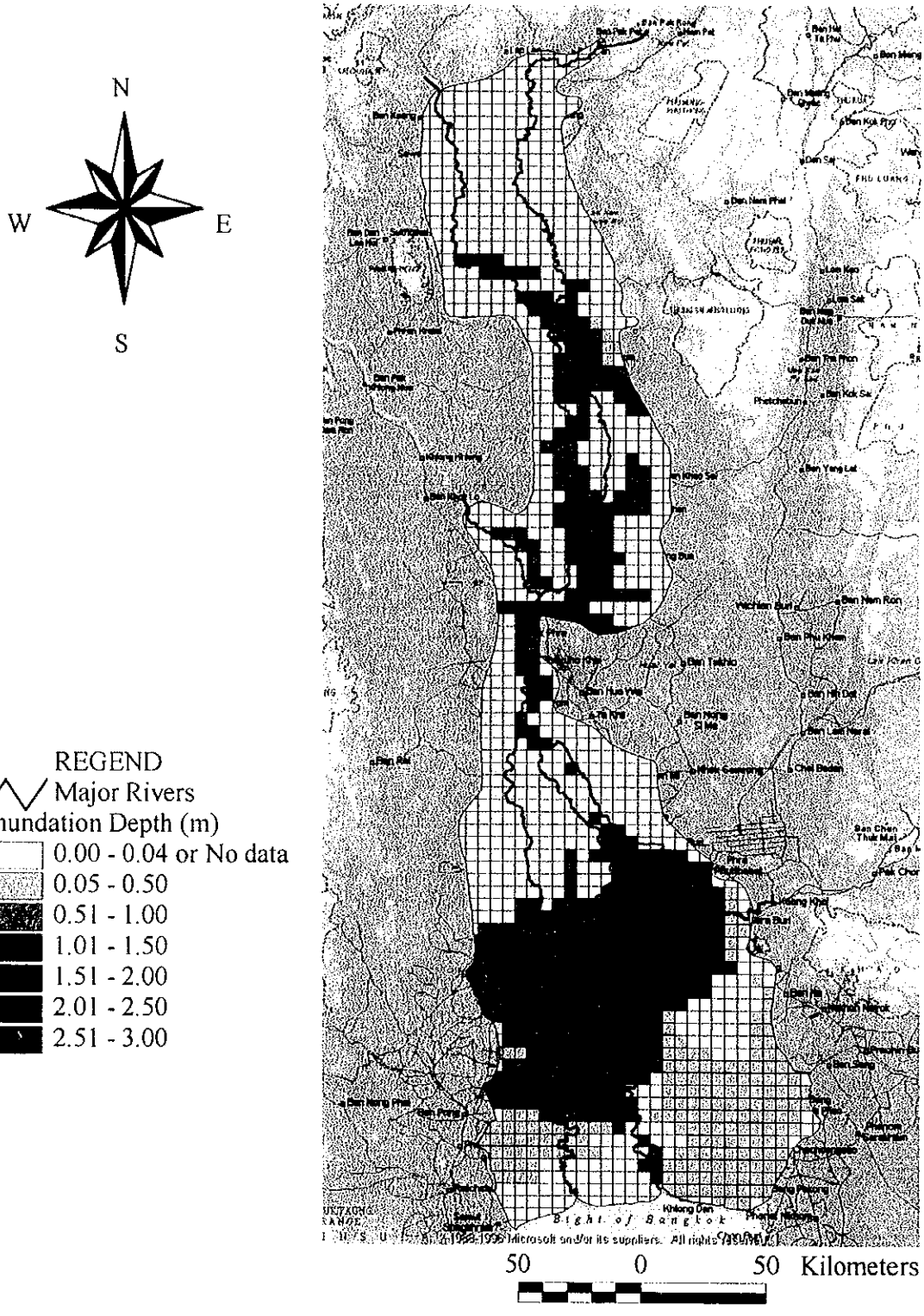
Note: Damage on private assets was not recorded.
Source: Dept. of Local Administration

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN	Fig.2.1.3 COMPONENTS OF FLOOD DAMAGE IN 1995 BY PROVINCE
CTI ENGINEERING CO., LTD. AND INA CORPORATION	



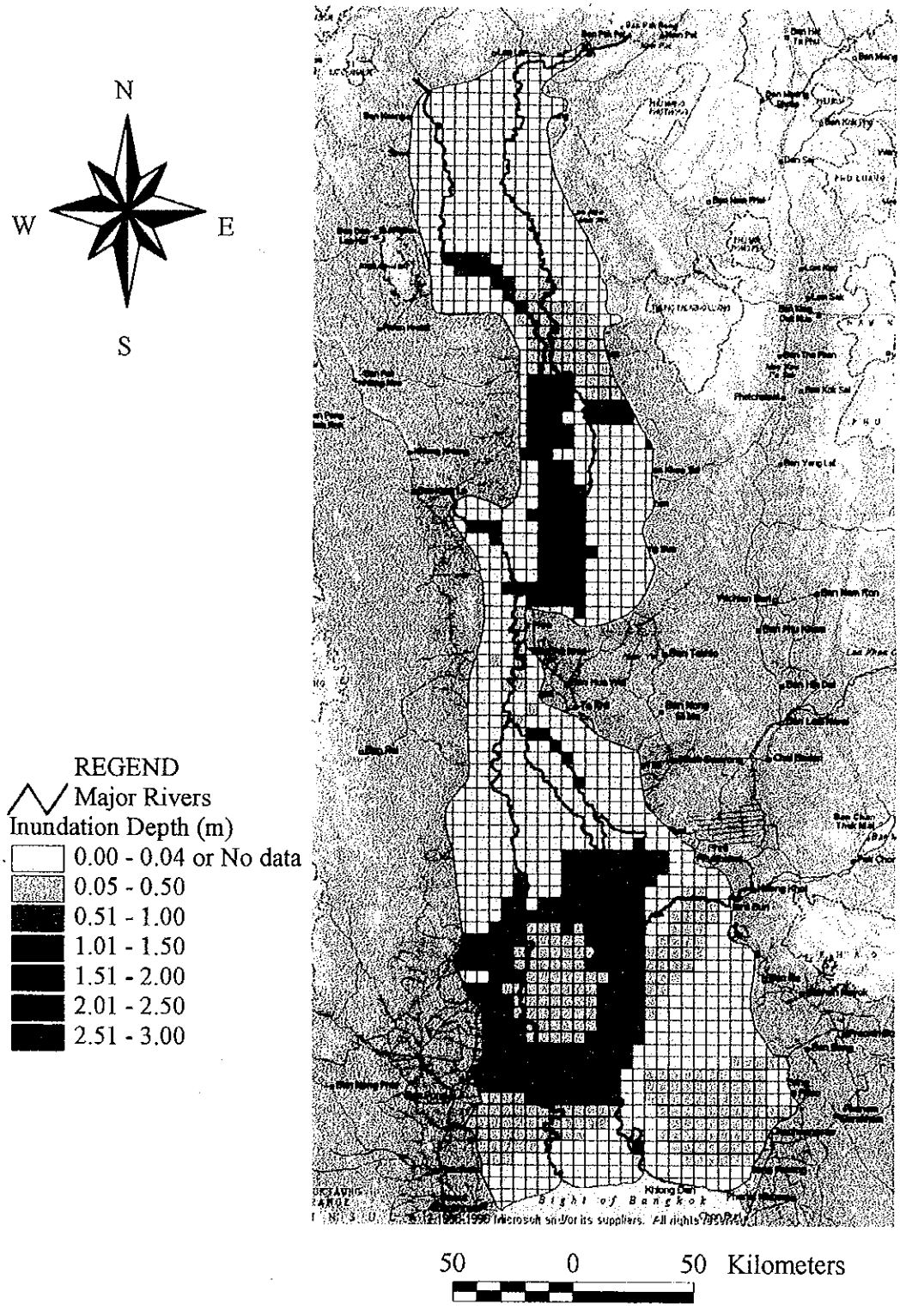
STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAOPHRAYA RIVER BASIN	Fig.2.2.1 STUDY AREA FOR DAMAGE ESTIMATION
CTI ENGINEERING CO LTD., & INA CORPORATION	

1995



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAOPHRAYA RIVER BASIN	Fig.2.3.1 INUNDATION DEPTH BY INTERVIEW SURVEY IN 1995
CTI ENGINEERING CO LTD., & INA CORPORATION	

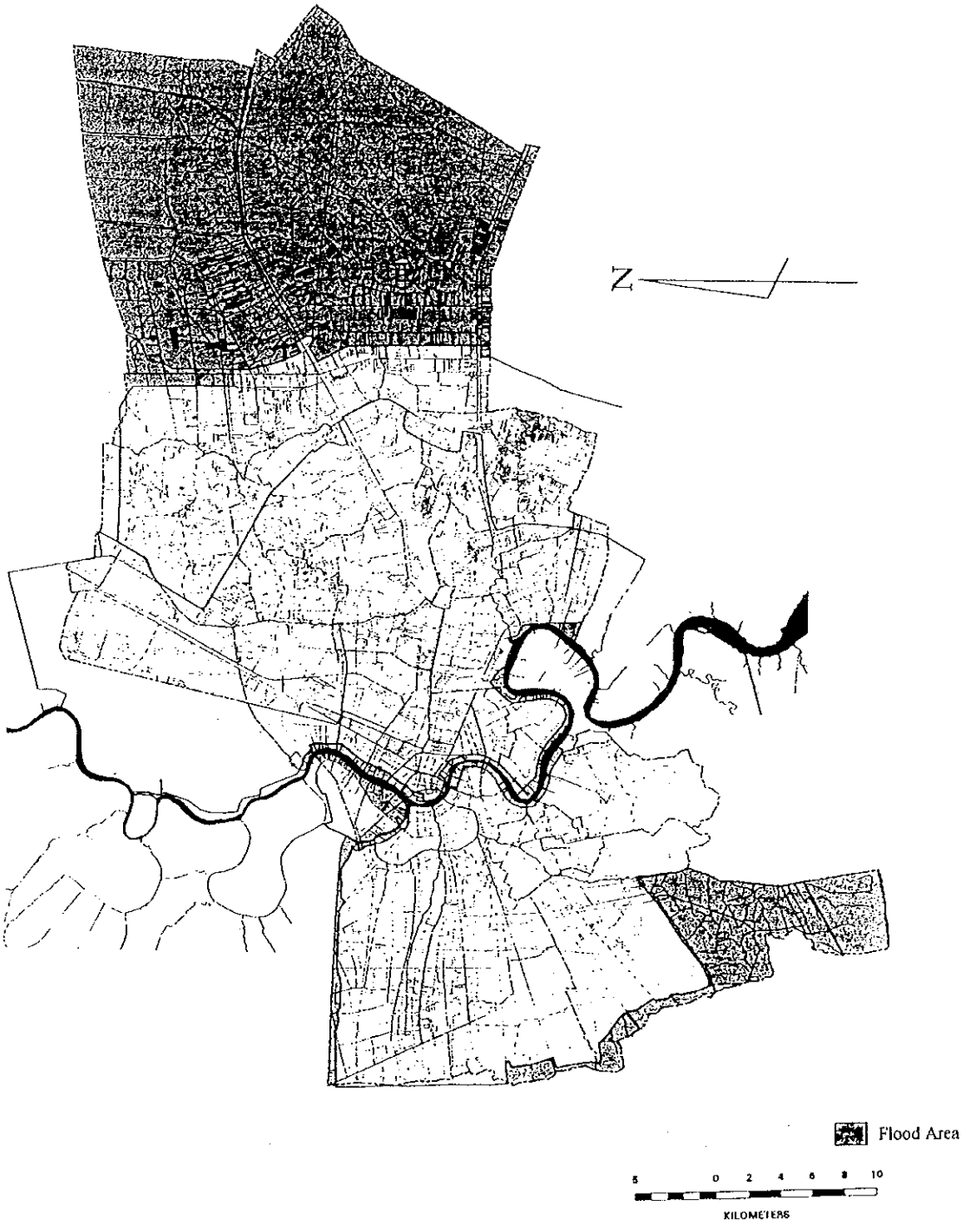
1996



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAOPHRAYA RIVER BASIN	Fig.2.3.2 INUNDATION DEPTH BY INTERVIEW SURVEY IN 1996
CTI ENGINEERING CO LTD., & INA CORPORATION	

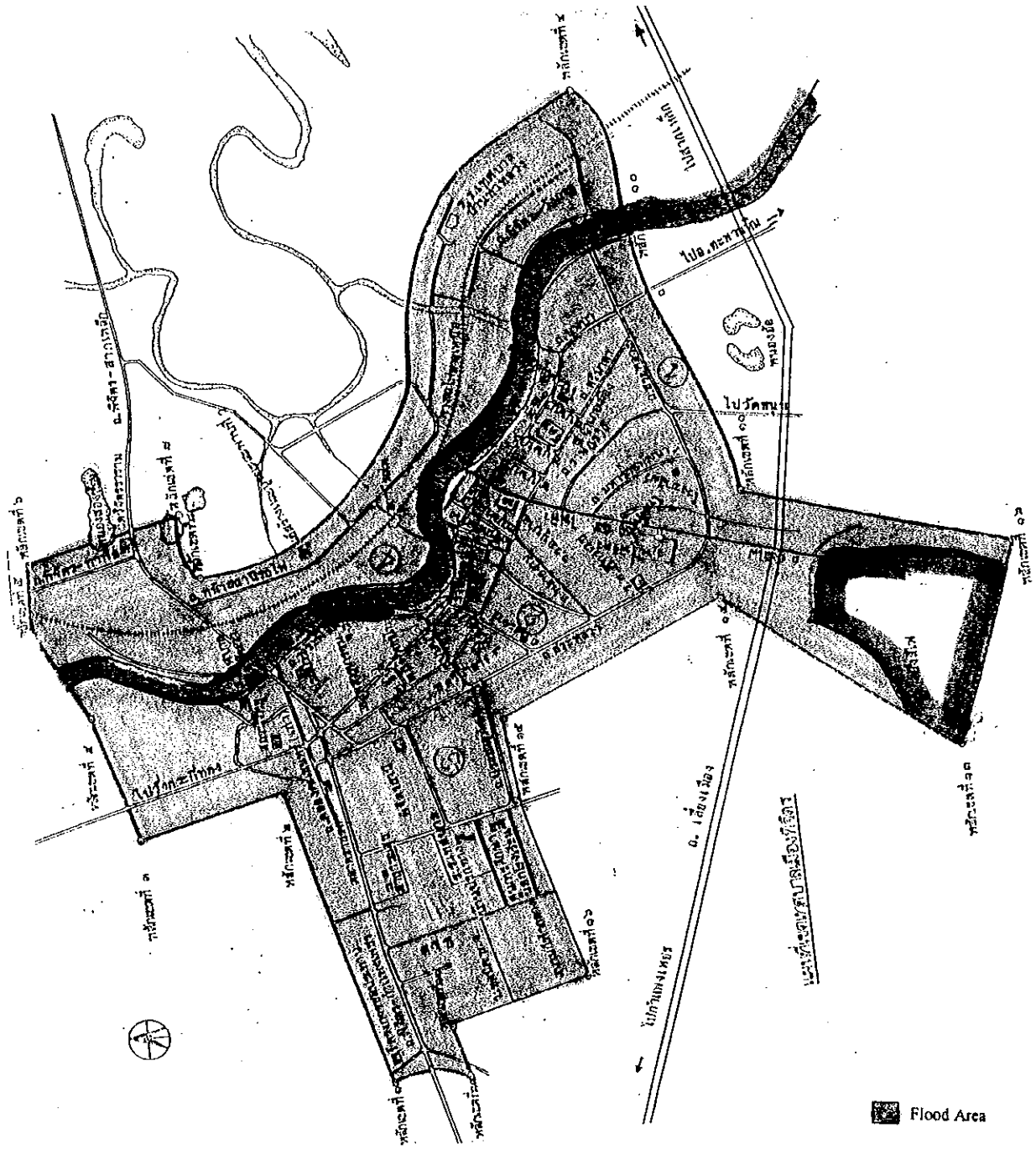
Source : The Study on Urban Environmental Inprovement Program in Bangkok Metropolitan Area, 1997
Pacific Consultants International & Suuri-Keikaku Co., Ltd.

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN	Fig.2.3.3 FLOODED AREA IN 1983 (BANGKOK)
CTI ENGINEERING CO., LTD. AND INA CORPORATION	

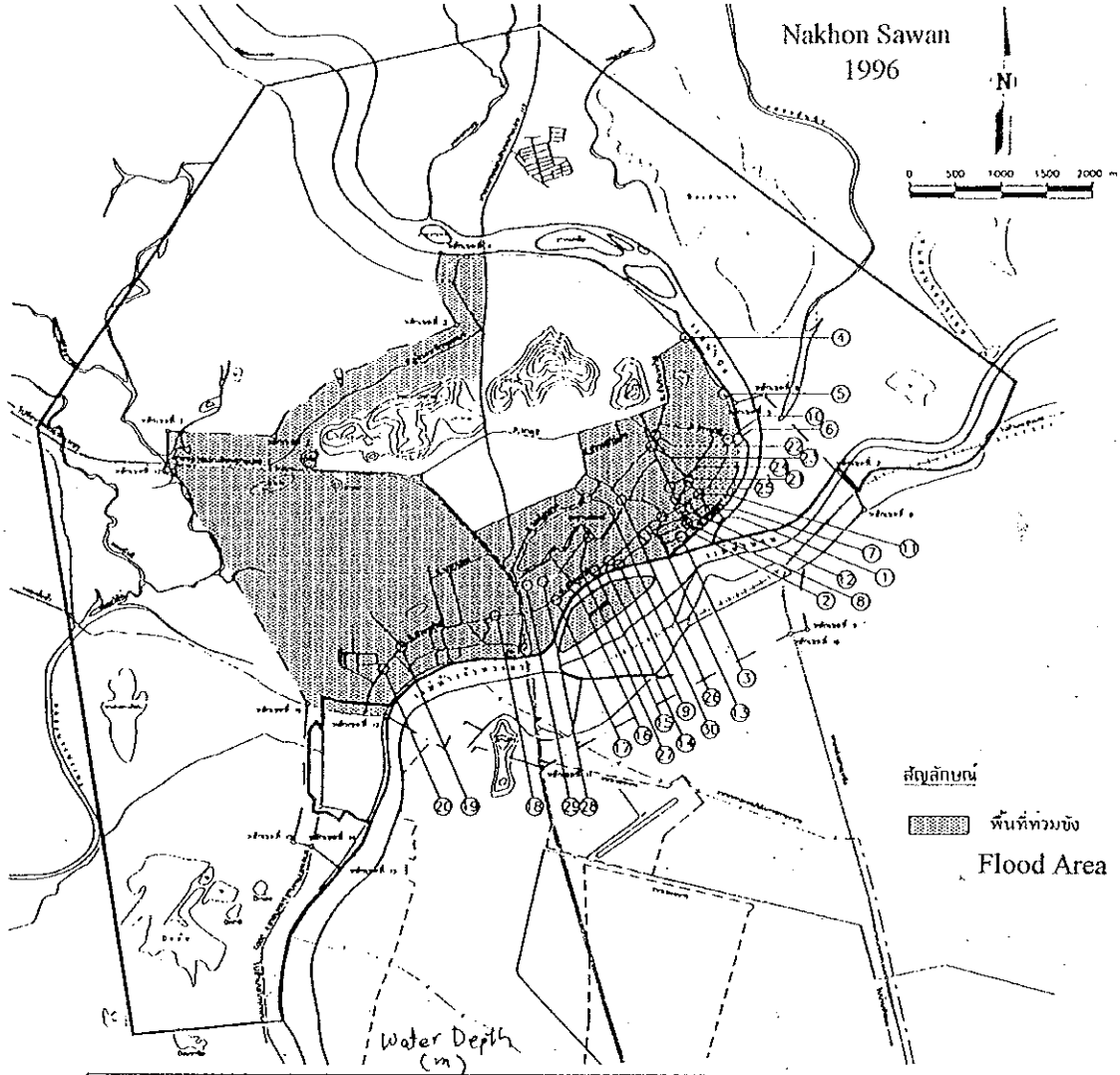


Source : The Study on Urban Environmental Inprovement Program in Bangkok Metropolitan Area, 1997
Pacific Consultants International & Suuri-Keikaku Co., Ltd.

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN CTI ENGINEERING CO., LTD. AND INA CORPORATION	Fig.2.3.4 FLOODED AREA IN 1995 (BANGKOK)



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN	Fig.2.3.5 FLOODED AREA IN 1995/1996 (PHICHIT)
CTI ENGINEERING CO., LTD. AND INA CORPORATION	



ลำดับที่	จุดวัดระดับน้ำ	ระดับน้ำ (ม.)	หมายเหตุ	ลำดับที่	จุดวัดระดับน้ำ	ระดับน้ำ(ม.)	หมายเหตุ
	ถนนเจ้าพระยา Road				ถนนสวรรค์วิถี		
①	- ถนนอรรถกวี	1.15		⑯	- ซอยสวรรค์วิถี 16	0.25	
②	- ถนนมาคุลี	1.23		⑰	- ถนนวิลาสวรรค์	0.24	
③	- ซอยวณิชย์	0.87		⑱	- หน้าวัดตาหอลิด	0.52	
	ถนนโกสีย์			⑲	- หน้าแรงงานจังหวัด	0.00	
④	- วัดไพรใต้	0.00		⑳	- หน้า สภ.อ. กองใต้	0.00	
⑤	- ถนนปาริชาติ	0.05			ถนนอรรถกวี		
⑥	- ถนนธรรมวิถี	0.47		㉑	- ถนนเทพนิมิตร	1.20	
⑦	- ถนนอรรถกวี	0.60		㉒	- ถนนอมราวิถี	0.38	
⑧	- ถนนมาคุลี	0.85			ถนนมาคลี		
⑨	- ถนนลูกเสือ	0.57		㉓	- ถนนพัฒวัน	0.80	
	ถนนสวรรค์วิถี			㉔	- ซอยละมอมมนตรี	0.83	
⑩	- ถนนธรรมวิถี	0.43		㉕	- ถนนอารักษ์	1.00	
⑪	- ถนนอรรถกวี	1.10			ถนนวงศ์สวรรค์		
⑫	- ถนนมาคุลี	1.00		㉖	- สมาคมยา	1.45	
⑬	- ถนนดาวดึงส์	0.50		㉗	- ถนนวิมานเมฆ	1.52	
⑭	- ถนนลูกเสือ	0.85		㉘	- ถนนวิลาสวรรค์	1.35	
⑮	- ถนนสวรรค์วิถี 12	1.45		㉙	- หน้าป้ายกุฑยานสวรรค์	0.50	
				㉚	- กองวัสดุเทศบาล	1.30	

รูปที่ 3.6 แผนที่แสดงบริเวณน้ำท่วมในเขตเทศบาลฯ ในปี 2538

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN CTI ENGINEERING CO., LTD. AND INA CORPORATION	Fig.2.3.6 FLOODED AREA IN 1995 (NAKHON SAWAN)