Lecture 5

Case of PHILIPPINES

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REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN

COUNTRY REPORT

Water Resources and River Management for Sustainable Development

OCTOBER 2002

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PART I : GENERAL SITUATION

1.1 Geographical and Meteorological Characteristics

1.1.1 Geography

The Philippines is an archipelago composed of about 7,100 islands and islets with an aggregate area of approximately 300,000 km2. It is bounded by the South China Sea on the west, by the Pacific Ocean on the east, by the Sulu and Celebes Sea on the South and by the Balintang Channel on the north. The country is divided into three major island groups, namely: Luzon, the largest, with an area of 141,000 km2, Mindanao, the southernmost major island, with 102,000 km2 and Visayas with 57,000 km2. The entire island group is closely scattered within the tropical belt and southeast of Asian mainland.

1.1.2 Topography

The topographical features of the country varies from the low marsh, which is about one foot above high water at the head of Manila Bay in the Luzon island to 2,954m above mean sea level, the height of the country's highest peak, Mt. Apo in the Mindanao island. The largest mountain areas and the most extensive plains are founding in the island of Luzon. The country has few inland lakes but many semi-enclosed bays. There are four large marshes – two in Luzon and two in Mindanao.

1.1.3 Geology

The following variety of rocks exist in the country: igneous, sedimentary and metamorphic. Basement complex is generally made up of gabbro, andesites, agglomerates, serpentine, greisses, schist, volcanic breccias, volcanic tuff, quartzite and basalt flows.

On the other hand, Philippine soils have considerable depth even on relatively steep slopes due to rapid chemical weathering and slow physical weathering of rocks. Hence, organic matter in the country is very small. Plant material in the tropical forest is about 2 to 3 times that in the temperate forest, but because of rapid chemical decomposition, very little humus is found. Carbon dioxide and organic acids provided by this plant material through attack the rocks, causing its rapid chemical weathering.

1.1.4 Climate

The Philippines is located in the tropics and the climate prevailing in any particular place in the country is influenced by its geographical position and wind system prevalent in different locations at certain times of the year. The classification of climatic conditions is based more on the type of rainfall than on slight differences in temperature. Four types of climate are adopted and are categorized as dry season and wet season induced by minimum or maximum rain period, as indicated below:

i) Type I : Two pronounced seasons, dry from November to April, wet during the rest of the year

ii) Type II : No dry season with a very pronounced maximum rainfall period from November to January

iii) Type III : Seasons are not very pronounced with relatively dry season from November to April and wet season during the rest of the year

iv) Type IV : Rainfall more or less distributed throughout the year

Figure 1.1.4 shows the distribution of climate regions in the Philippines.

Rainfall intensities range from very light to heavy and may occur as continuous, intermittent, or showery. Precipitation is influenced by prevailing air streams or monsoons, tropical typhoons, the Inter-tropical Convergence Zone, topography, fronts, easterly waves, and local thunderstorms.

The country has a wide range of precipitation with the highest intensity of 9,006mm recorded in 1910 in Baguio City and lowest of 94mm in Ilocos Sur in 1948, both places in Luzon. The average yearly precipitation is 2,360mm over the numerous rain gauging stations in the islands.

1.1.5 Typhoons

The Philippines is located along the path of tropical cyclones generated in the Pacific Ocean. About twenty (20) tropical cyclones a year originates from this area out of which nine (9) affect the country. From 1948 to 1999, the Philippines experienced a total of five hundred thirty seven (537) tropical cyclone passages. The graphical distribution of these passages is shown in Figure 1.1.5.

1.2 Population and Land Use

1.2.1 Population

The Philippines has a total population as of 76.5 million, that corresponds to a population density of 228 persons/km^2. Out of the total, about 13% lives in the Metropolitan Manila Area (15,690 persons/km^2), the political and economic/trade center of the country. Population growth peaked in 1970 at 3.08%/year but decreased through the years recording 2.32%/year in 1990-1995.

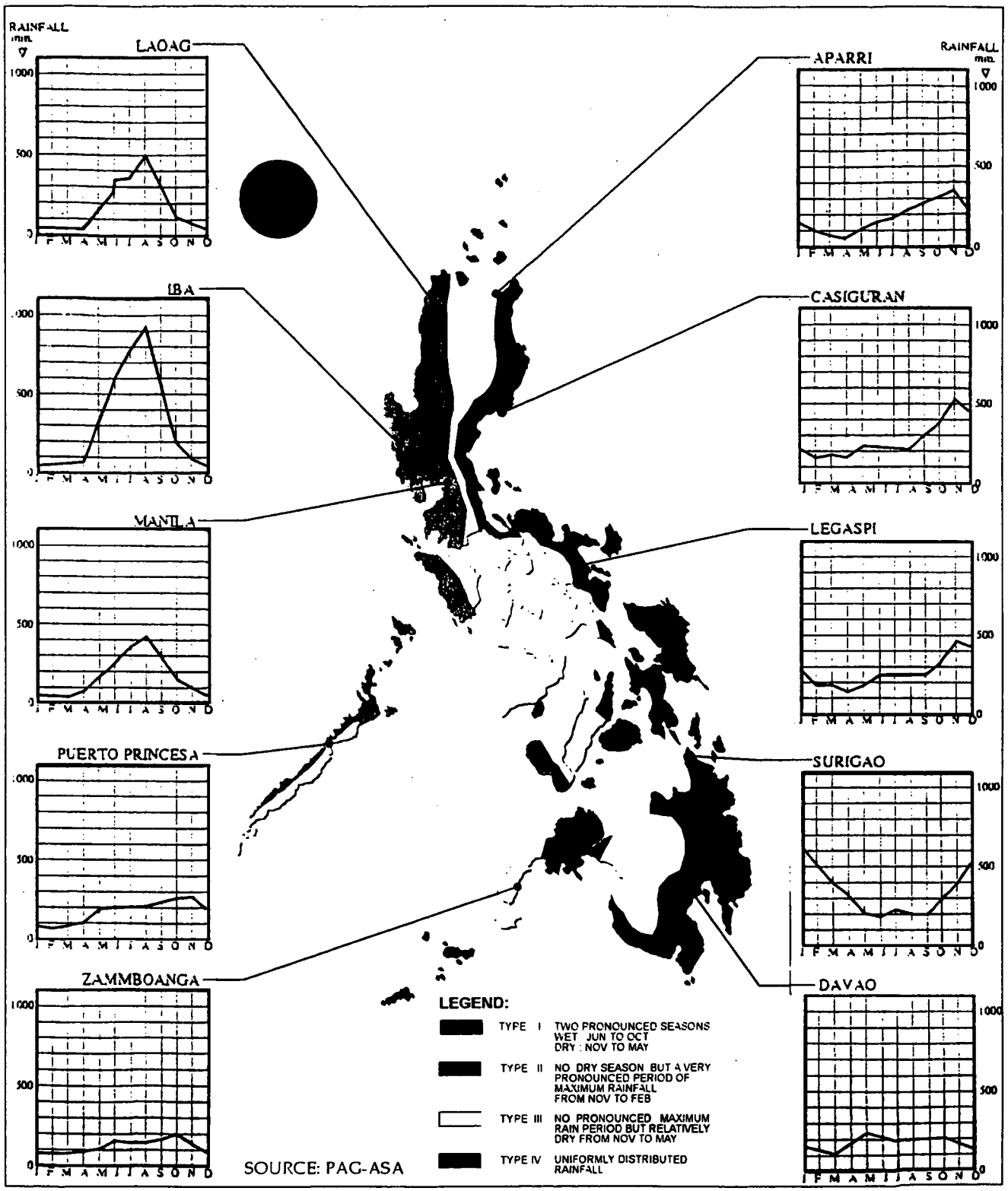


Figure 1.1.4

Climate Regions of the Philippines

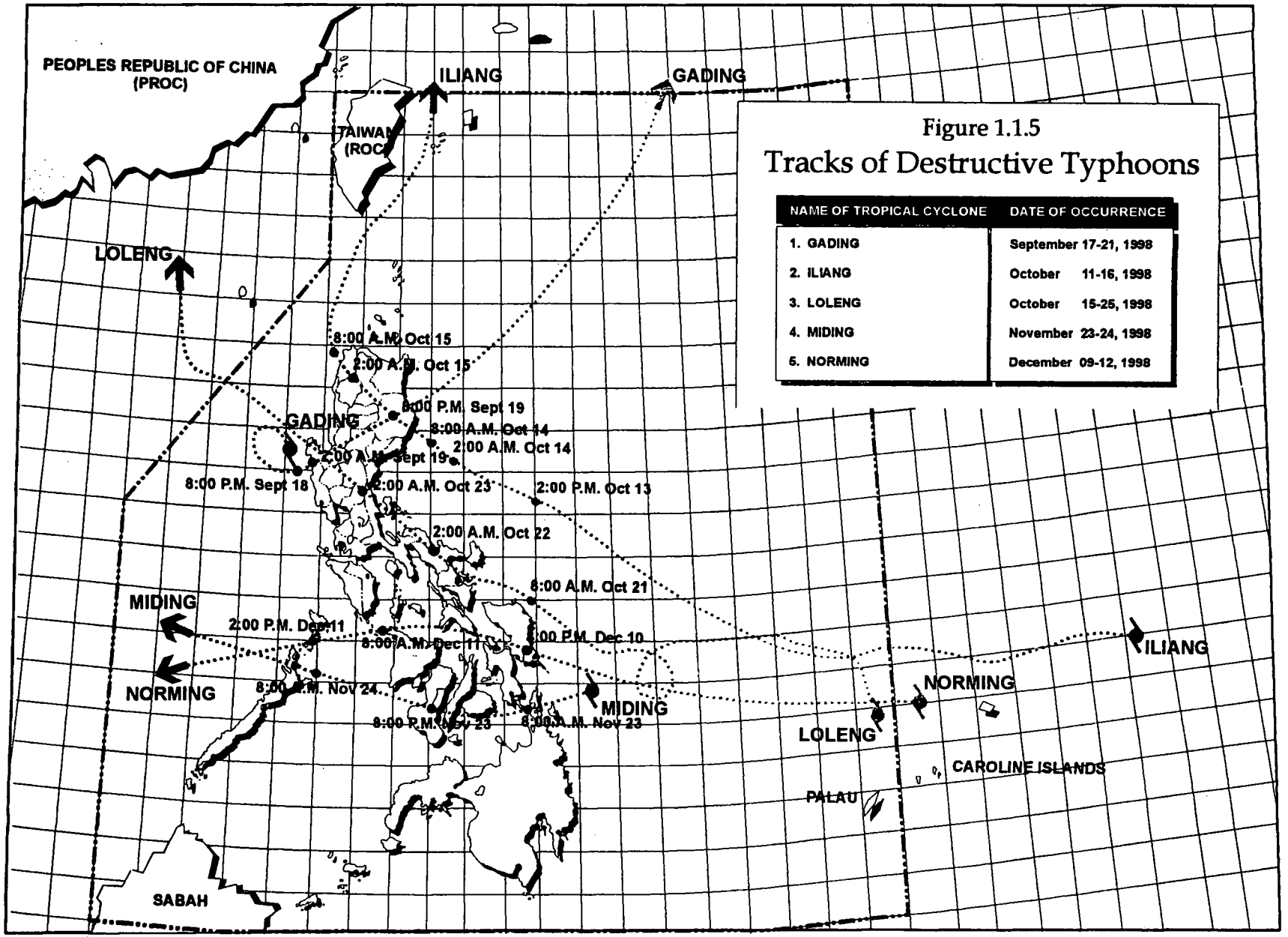


Figure 1.1.5

Tracks of Destructive Typhoons

NAME OF TROPICAL CYCLONE	DATE OF OCCURRENCE
1. GADING	September 17-21, 1998
2. ILIANG	October 11-16, 1998
3. LOLENG	October 15-25, 1998
4. MIDING	November 23-24, 1998
5. NORMING	December 09-12, 1998

Table 1.2.1
Population and Density by Region, as of 2000

Region	Population (thousands)	Density (person/km^2)
NCR (National Capital Region)	9,932	15,690.00
CAR	1,365	70.56
Region 1	4,200	333.40
Region 2	2,813	90.28
Region 3	8,030	438.00
Region 4	11,794	239.70
Region 5	4,674	258.00
Region 6	6,208	303.72
Region 7	5,701	363.16
Region 8	3,610	155.33
Region 9	2,831	167.44
Region 10	3,505	174.86
Region 11	3,676	173.10
Region 12	3,222	143.36
Region 13	2,095	98.46
ARMM	2,803	116.90
Total	**74,498**	**228.00**

1.2.2 Land Use

The Philippines has a territory of 300,000 km^2, classified into forest land of 158,883 km^2 and alienable/disposable land of 141,117 km^2 as of December 1995. The alienable/disposable land covers the urban area, the industrial areas and all other alienable and disposable land, while the forest land includes residential area of 32, 729 km^2 (23.1%), timberland of 101,159 km^2 (71.7%), national parks of 13,411 km^2 (9.4%), military & naval reservation of 1,303 km^2 (0.9%), civil reservation of 1,660 km^2 (1.2%) and fishpond of 756 km^2 (0.5%). Land Classification by region is shown in Table 1.2.2.

Table 1.2.2
Land Classification by Region, as of 2000

(Unit: Km^2)

Region	Total Land	Alienable and Disposable Land	Forest Land
NCR	636	482	154
CAR	18,293	3,407	14,887
Region 1	12,840	8,101	4,740
Region 2	26,838	9,601	17,237
Region 3	18,231	10,519	7,712
Region 4	46,924	21,613	25,312
Region 5	17,632	12,221	5,412
Region 6	20,223	14,088	6,135
Region 7	14,951	9,592	5,359
Region 8	21,432	10,237	11,195
Region 9	15,997	7,623	8,375
Region 10	28,328	10,669	17,658
Region 11	31,693	12,124	19,568
Region 12	14,373	5,468	8,904
ARMM	11,608	5,428	6,180
Total	**300,000**	**141,172**	**158,828**

PART 2: RIVERS IN THE PHILIPPINES

2.1 Principal / Major River Basins

There are 421 principal river basins in the country with drainage areas ranging from 41 km^2 to 25,649 km^2. About 60% of these river basins have drainage areas ranging from 100 km^2 to 500 km^2, as listed below.

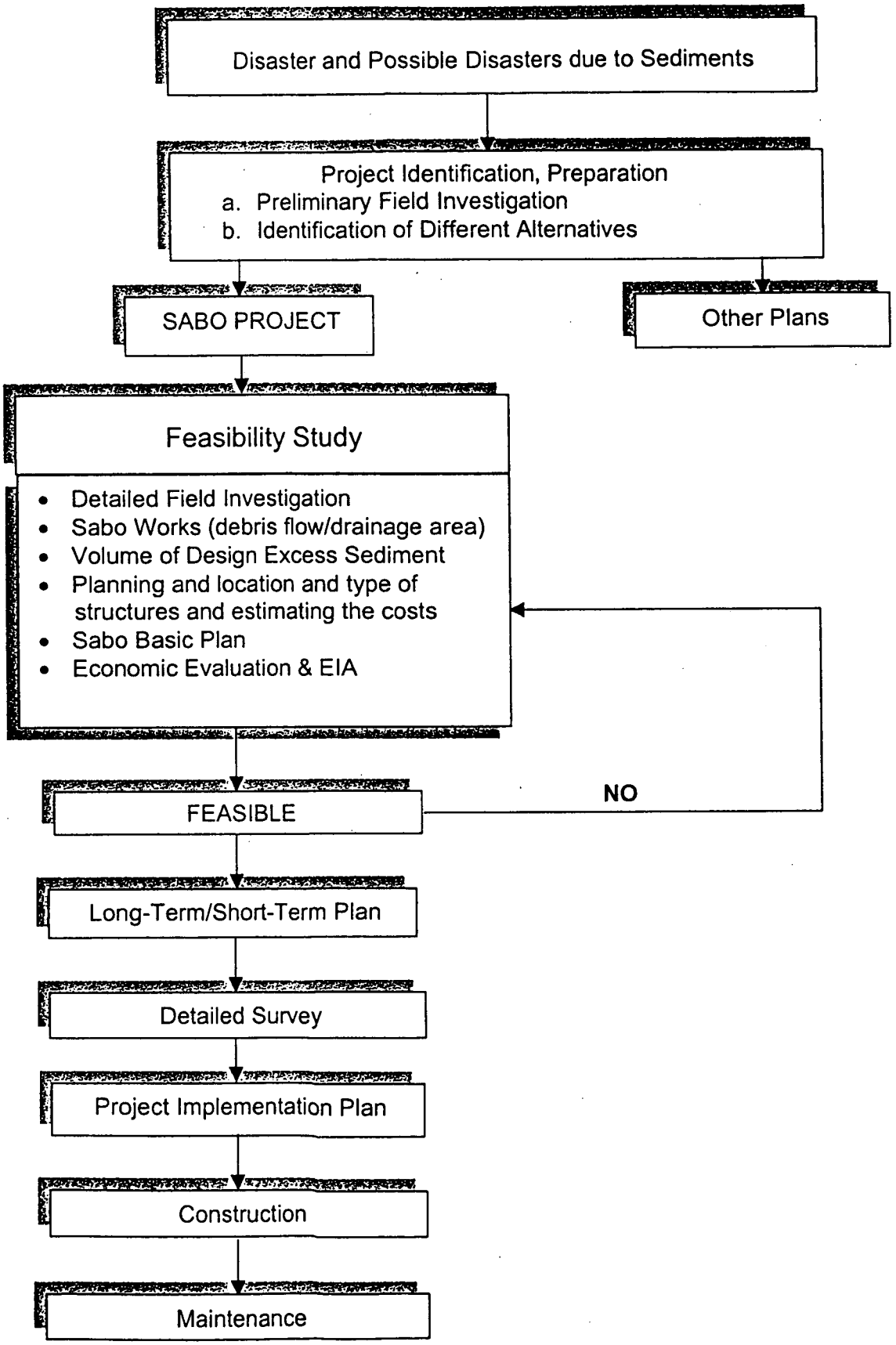
Drainage Area (km^2)	Number of River Basins
50-100	51
101-200	113
201-500	155
501-1,000	63
1,001-2,000	22
2,001-5,000	9
5,001-10,000	5
>10,000	3

Of the 421 principal river basins, 20 are considered major rivers with catchment areas of more than 1,000 km^2. The largest river basin in the country is the Cagayan River basin with a catchment area of 25,649 km^2 located in the Cagayan Valley Region. Figure 2.1 shows the major rivers while Table 2.1 below lists the major rivers and catchment areas.

Table 2.1
Major River Basins

No.	River System	Region	Catchment Area (km^2)	River Length (km)
1	Cagayan	Cagayan Valley	25,649	505
2	Mindanao	Southern Mindanao	23,169	373
3	Agusan	CARAGA	10,921	350
4	Pampanga	Central Luzon	9,759	260
5	Agno	Central Luzon	5,952	206
6	Abra	Ilocos	5,125	178
7	Pasig-Marikina-Laguna de Bay	NCR, Southern Tagalog	4,678	78
8	Bicol	Bicol	3,771	136
9	Abulug	Cagayan Valley	3,372	175
10	Tagum-Libuganon	Southeastern Mindanao	3,064	89
11	Ilog-Hilabangan	Western Visayas	1,945	124
12	Panay	Western Visayas	1,843	132
13	Tagoloan	Northern Mindanao	1,704	106
14	Agus	Southern Mindanao	1,645	36
15	Davao	Southeastern Mindanao	1,623	150
16	Cagayan de Oro	Northern Mindanao	1,521	90
17	Jalaur	Western Visayas	1,503	123
18	Buayan-Malungun	Southeastern Mindanao	1,434	60
19	Laoag	Ilocos	1,353	73
20	Amnay-Patrick	Southern Tagalog	993	58

PROCEDURE ON SABO WORKS



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MAJOR RIVER BASINS IN THE PHILIPPINES

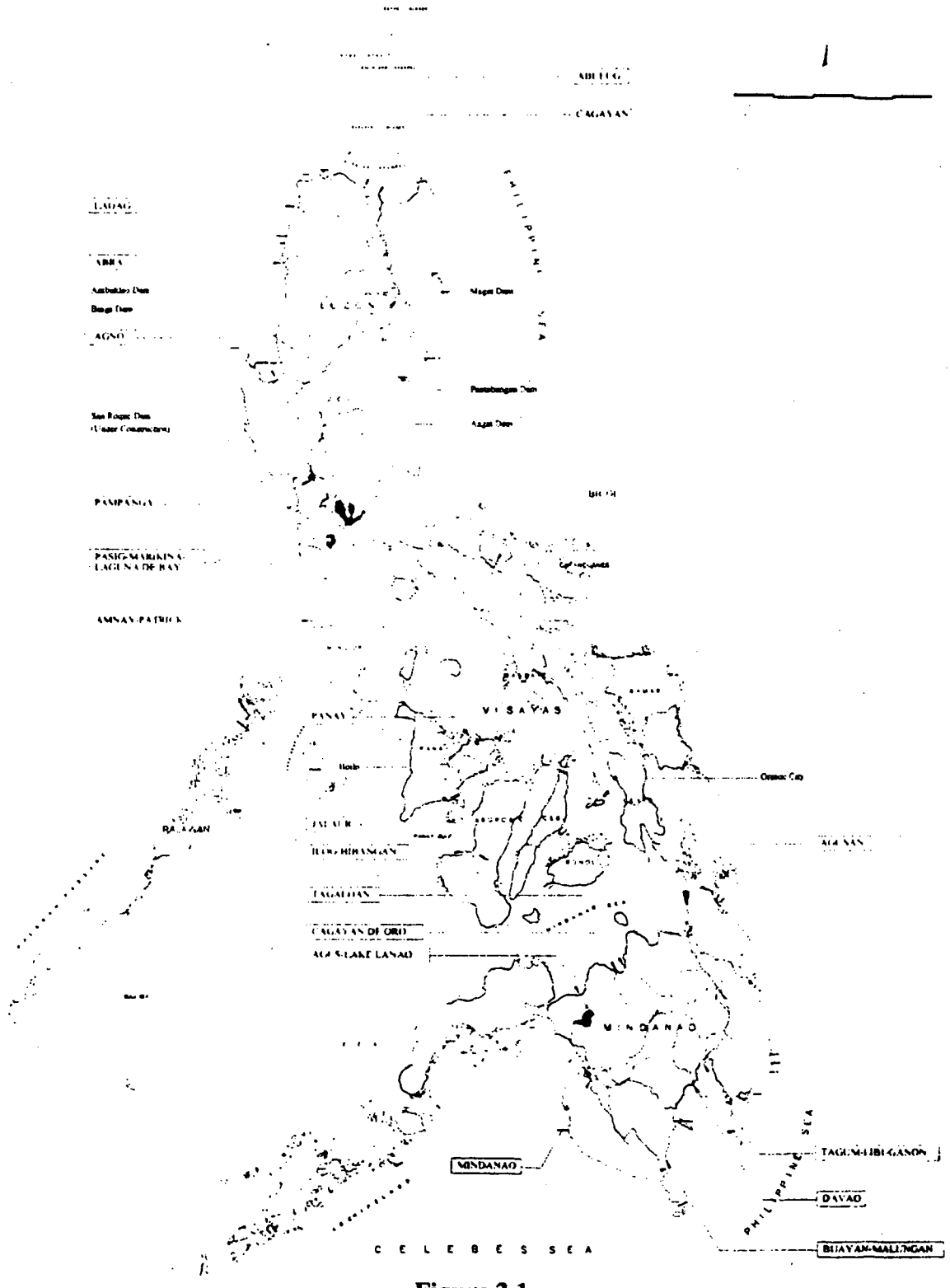

Figure 2.1

PMO - Major Flood Control Projects
PMO - Flood Control and Sabo Engineering Center

2.2 Conditions of River Systems

Rivers in the Philippines are characteristically short and steep. Most of the rivers flow directly from mountain headwaters to the sea. The aforementioned major river basins, however, have river delta ranging from 50 kms. to 280 kms.

In comparison with rivers in other parts of the world, most of major Philippines rivers are short and steep with channel gradients ranging from 0.40% - 0.70%. However, the two largest Philippines rivers, i.e., Cagayan and Cotabato rivers, have channel gradients of 0.08% and 0.13%, respectively.

Cagayan River which is the largest, has relatively gentle slope with a length of approximately 475 km and elevation of about 4000 m. It traverses the entire length of the Cagayan Valley flowing in a northerly direction from its headwaters in Quirino Province to its mouth in the Babuyan Channel.

Mindanao River is the second largest, having an approximate length of 405 km and headwater elevation of 550 m located in Bukidnon. At the convergence point of major tributaries of the river about 200 km from the river mouth, the Liguasan Marsh is formed by overflowing. The marsh covers an area of approximately 280,000 hectares cutting across the tree provinces in North Cotabato, Sultan Kudarat and Maguindanao.

Common to all major river systems in the Philippines is the inadequacy of the existing river channel carrying capacity which generally corresponds to only about 2.0 yr. probable flood.

2.3 Problems and Issues

2.3.1 Flood Disaster

The Philippines due to its geographical location is one of the most disaster-prone countries in the world. It lies along the path of about 20 tropical cyclones a year, about 9 of which directly affect the mainland and cause enormous damage to lives and properties. These cyclones are often accompanied with destructive wind forces that cause storm surges and heavy rainfall which result in inundation in river basins and low-lying areas.

Total cumulative damage for the last 20 years had reached approximately ₱124 Billion and has caused loss of lives of 27,000 casualties. Damaged to houses affects as average of 502,000 families annually.

Damages caused by typhoons experienced in the Philippines from 1970-1999, including their dates of occurrences, areas affected and corresponding damages, are shown in Table 2.3.1 below.

Table 2.3.1
Damages of Destructive Typhoons
1970-1999

Year	Casualties			Population Affected		Houses Damaged		Value of Damages (Million Peso)
	Dead	Missing	Injured	Families	Persons	Totally	Partially	
1970	1,328	494	1,917	18,370	109,980	-	-	501
1971	89	110	72	-	-	-	-	40
1972	298	5	33	-	-	-	-	178
1973	74	89	24	2,024	12,144	-	-	250
1974	153	89	118	97,085	444,330	1,441	4,589	365
1975	39	8	8	4,518	26,523	698	1,547	19
1976	313	185	37	504,510	2,744,379	3,917	4,912	725
1977	99	23	118	137,411	821,638	15,679	16,115	335
1978	663	395	834	520,405	2,853,104	68,376	94,147	1,575
1979	69	68	79	155,919	924,326	54,283	58,649	415
1980	143	29	55	306,895	1,666,498	16,510	47,573	1,465
1981	484	264	1,922	250,965	1,472,417	93,965	159,251	1,275
1982	337	223	347	266,476	1,569,022	84,042	97,485	1,659
1983	126	28	168	140,604	747,155	29,682	85,072	522
1984	1,979	732	4,426	741,510	4,048,805	310,646	313,391	5,869
1985	211	300	17	318,106	1,643,142	8,204	211,151	2,725
1986	171	43	151	287,140	1,414,188	7,106	36,357	1,777
1987	1,020	213	1,455	668,628	3,882,534	242,336	345,370	4,083
1988	429	195	468	1,173,994	6,081,566	134,344	355,459	8,676
1989	382	89	1,087	502,600	2,582,822	56,473	184,584	4,494
1990	670	262	1,392	1,265,652	6,661,474	223,525	636,742	12,678
1991	5,199	4,281	355	150,894	759,335	15,458	83,664	4,187
1992	117	95	53	352,944	1,755,811	3,314	8,006	5,071
1993	794	200	1,634	1,446,031	7,465,711	164,174	444,909	19,987
1994	242	48	247	617,228	3,056,232	58,567	223,358	6,381
1995	1,204	642	3,025	1,561,334	7,693,526	294,147	719,124	15,256
1996	124	50	90	260,581	1,255,289	2,690	17,559	2,834
1997	91	8	44	442,298	2,204,761	2,325	20,546	1,046
1998	498	106	873	1,590,905	7,197,953	137,020	406,438	17,822
1999	56	3	25	270,424	1,281,194	144	687	1,555
TOTAL	17,402	9,277	21,074	14,055,451	72,375,859	2,029,066	4,576,685	123,765
AVERAGE	580	309	702	501,980	2,584,852	78,041	176,026	4,126

Source : National Disaster Coordinating Council (NDCC)
• : Based on Current Prices

2.3.2 Key Problems in Philippine Rivers

2.3.2.1 Urban development within the confines of river waterway and flood plain.

- Restricts flood flows resulting in increased localized riverbed aggradation/degradation, localized bank erosion and damage to existing flood control facilities
- Loss of life and property from severe floods
- Restricts access to existing flood control facilities for maintenance works
- Delays new flood control project implementation

2.3.2.2 Deafforestation and resulting increased sediment runoff into river systems

- Increased sediment runoff into river systems result in localized bank erosion, localized riverbed aggradation and degradation and reduced storage capacity to water impounding structures

2.3.2.3 The Philippines is in a volcanic/earthquake region hence volcanic eruptions and earthquakes impacts on river systems

- Volcanic eruption (Mt. Pinatubo-1991) resulting in substantial effusion of lahar into river systems leading to significantly increased riverbed aggradation and damage to existing facilities such as bridges, dikes, etc.
- Earthquake damage to existing facilities is always significant like the Luzon 1990 earthquake – magnitude 7.8

2.3.2.4 Compared to other infrastructure sectors like roads, bridges, flood control sector is in a lower priority which results to less allocation than necessary, hence, staged implementation

2.3.2.5 Reliance on ODA/Foreign Assistance. Like other developing countries, the Philippines relies on ODA / Foreign assistance for major flood control projects

PART 3: RIVER IMPROVEMENT ACTIVITIES

3.1 Development Policies

The Department of Public Works and Highways (DPWH) is the government agency responsible for the planning, design, construction and maintenance of flood control projects in all major river basins. It has developed policies and strategies which addresses issues, structural and non-structural, related to river improvement works as follows:

a) Mitigate flooding to tolerable levels in Metro Manila and major river basins with the additional construction/installation of flood control facilities such as dikes, river walls, levees, cut-off channels, diversion floodways, revetments and installation of pumping stations, dredging and related works.

b) Provide adequate flood control and facilities in all flood prone areas that need protection as determined under the national land use plan.

c) Coordinate the development of flood control projects with the implementation of irrigation projects.

d) Pursue comprehensive planning of major river basins and implementation of flood control structures on identified flood prone areas including proper river management.

e) Pursue the installation of flood forecasting and warning system in all river basins.

f) Relocate squatters living along the banks of rivers/esteros/creeks in coordination with other concerned government agencies.

g) Pursue maintenance of facilities against lahar and dredging/desilting activities to increase flood conveyance capacities of river channels.

h) Put up viable and effective garbage collection and disposal systems for areas near rivers/esteros/waterways used for drainage.

i) Pursue proper maintenance and up-keep of existing drainage system through the concerted efforts by the national government and LGUs.

j) Organize flood reaction teams and Bantay Estero/Ilog brigades among LGUs in coordination with the tri-media.

k) Put-up an effective flood monitoring system.

l) Establish the Flood Control and Sabo Center to conduct applied research and development and human resource development.

3.2 Flood Control Projects in Major River Basins and Urban Centers

In line with the foregoing policies, the DPWH is currently implementing major river improvement works listed in Table 3.2. Due, however, to fund limitations, the DPWH is able to implement only a few of its major flood control works with emphasis on major river basins having completed the Master Plan/Feasibility Study status, with assistance from foreign lending institution notably from the Japan Bank for International Corporation and the Japan International Cooperation Agency.

Table 3.2
FEATURES AND FLOOD CONTROL PROGRAMS OF MAJOR RIVER BASINS
As of May 2002

GENERAL INFORMATION							COMPLETED / ON-GOING PROGRAMS									FUTURE PROGRAMS		
					RIVER DESCRIPTION		STUDY					IMPLEMENTATION						
Code No.	Name of River Basin	Region	Province	Catch. A. (sq. km.)	Section	Feature	Agency	Year	Type	Title/Scope	Status	Agency	Year	Project Description	Status	Study/ Agency	Implementation Phase/Package	Priority
1	Laoag	I	Ilocos Norte	1,353		Sedimentation Problem	JICA	1996-97	MP/FS	Sabo/Flood Control	Completed	JBIC	2001	Sabo Dams River Improvement	On-going	D/D OECF	24-YL	A
2	Abra	I CAR	Abra	5,125		Sedimentation Problem												C
3	Cagayan	II	Cagayan Isabela Quirino Nueva Vizcaya	25,649	Whole	Largest River	JICA	1985-87	M / P	Water Res. Dev.	Completed							-
					Lower	Flooding Due to Narrow Sections	JICA	2000-02	F / S	Flood Control	On-going					D/D OECF	27-YL	A
					Upper											FS/DD		B
4	Abulug	II CAR	Cagayan Apayao	3,372														C
5	Agno	CAR I II	Benguet Pangasinan Tarlac	5,952	Whole	Flooding/Sedim.	JICA	1988-91	F / S	Flood Control	Completed							-
					Lower				D / D			OECF	1995	PH-1	On-going			-
					Middle	Poponto Swamp			D / D			OECF	1998	PH-2A	On-going		PH-2B / 24-YL	A
					Upper												PH-3 / 26-YL	A
					Lower-Sinocalan											FS/DD JICA		A
					Tarlac River	Lahar										PH-2B	PH-3	A
6	Pampanga	III	N. Vizcaya Pampanga Bulacan	9,759	Delta	Delta-Development w/ Opposition	JICA	1979-82	M / P	Flood Control	Completed	16-YL	1990	PH-1	Completed		PH-2 / 26-YL	A
							13-YL	1986-89	D / D	Flood Control	Completed							
					Upper											MP / FS		B
7	Pasig-Marikina Laguna Lake	NCR IV-A	Metro Manila Rizal Laguna	4,678	Metro Manila	Pumping Stations						1-YL	1973-83	10 Pumping Sta.	Completed		Rehabilitation	B
												12-YL	1984-87	2 Pumping Sta.	Completed			
												14-YL	1988-98	3 Pumping Sta.	Completed			
						Mangahan FW						4-YL	1975-88	Floodway	Completed			-
						EFCOS						11-YL	1983-93	FC Operation	Completed			-
												GOJ/GA	2000-	Rehabilitation	On-going			A
						West of Manga-han Floodway	JICA	1987-90	F/S	Flood Control	Completed	21-YL	1996	North Laguna Flood Control	On-going			-
							16-YL	1990-96	D/D	Flood Control	Completed							
						KAMANAVA	JICA	1987-90	F/S	Flood Control	Completed	SYL	2000	Flood Control	On-going		Special-YL	A
							DPWH	1998	Re-FS	Flood Control	Completed							
						Drainage Main/Laterals Esteros						GOJ/GA	1989	Retrieval	Completed			-
												GOJ/GA	1992	Retrieval 2	Completed			-
							JICA	2000	Pre-FS	Flood Control	Completed					F/S		A
					Pasig-Marikina River	Channel Improvement	JICA	1987-90	F/S	Flood Control	Completed						25-YL	A
							SAPROF	1997-98	F/S	Flood Control	Completed							
							23-YL	1999	D/D	Channel Improv.	On-going							
					Pasig River	Dredging						Belgium	2000-	Dredging	On-going			-
					San Juan R.	Dredging						GOP	2000-	Dredging	On-going			-

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					Section	Feature	Agency	Year	Type	Title/Scope	Status	Agency	Year	Project Description	Status			
8	Amnay-Patrick	IV-B	Occidental Mindoro	1,353		Sedimentation & Flooding	7-YL	1996-97	MP/FS	NFCPRDP	Completed						FCSEC - Pilot Area for FC/Sabo	A
							DPWH	1984	Pre-FS	Multi-purpose	Completed							
9	Bicol	V	Camarines Sur	3,771		Flooding in Urban Area	7-YL	1978-82	M/P	NFCPRDP	Completed							
			Albay				BRBDP	1983	F/S	Flood Control Component	Completed	DPWH	1973-91	Cut-off/Diversion Channels	Completed			B
							BRBDP (ADB)	1992	D/D	& Irrigation Flood Control	Completed							
10	Panay	VI	Capiz, Iloilo	1,843		Flooding	7-YL	1978-82	M/P	NFCPRDP	Completed					FS		B
11	Jalaur	VI	Iloilo, Antique Capiz	1,503			7-YL	1978-82	M/P	NFCPRDP	Completed							C
12	Ilog-Hilabangan		Negros Occidental Negros Oriental	1,945		Flooding at Lower Reaches	7-YL	1978-82	M/P	NFCPRDP	Completed							B
							JICA	1989-91	M/P	Flood Control								
13	Agusan	CARAGA	Agusan del Norte	10,921	Lower	Flooding in Urban Area	7-YL	1978-82	M/P	NFCPRDP	Completed							-
			Agusan del Sur				10-YL	1982-85	D/D	Flood control	Completed	14-YL	88-99	PH-1, West Bank	Completed			-
			Surigao del Sur									21-YL	1996	PH-2, East Bank	On-going			-
			Surigao del Norte		Whole	Bunawan Marsh	7-YL	1978-82	M/P	NFCPRDP	Completed					FS/JICA		A
14	Tagoloan	X	Misamis Oriental Bukidnon	1,704		Sedimentation & Flooding	7-YL	1978-82	M/P	NFCPRDP	Completed							C
15	Cagayan de Oro	X	Misamis Oriental Bukidnon	1,521		Flooding in Urban Area	LGU	1999	M/P	Flood Control & Env'l Improvt.								B
16	Tagum-Libuganon	XI	Davao	3,064		Flooding in Urban Area	NIA-DPWH		F/S	Flood Control & Irrigation	Completed	NIA		Diking-Left Bank	Completed			C
												DPWH		Diking-Right Bank	On-going			
17	Davao	XI	Davao	1,623		Flooding in Urban Area	Davao City	1998	M/P, F/S	Drainage	Completed							C
18	Buayan-Malingan	XI	South Cotabato Davao del Sur	1,434														C
19	Agus	XII	Lanao del Norte	1,645														C
20	Mindanao	XII ARMM	Maguindanao Sultan Kudarat South Cotabato North Cotabato Bukidnon	23,169	Whole	Constricted Sec. causes the flood at midstream Liguasan Marsh	7-YL	1978-82	M/P	MFCPRDP	Completed							-
							NEDA	1997	M/P	Liguasan M. Development	Completed							
							PHRD WB	1999-	M/P	Watershed Management	On-going							

Note: NFCPRDP - National Flood Control Project and River Dredging Program

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FEATURES AND FLOOD CONTROL PROGRAMS OF MAJOR RIVER BASINS
As of May 2002

GENERAL INFORMATION							COMPLETED / ON-GOING PROGRAMS									FUTURE PROGRAMS		
							STUDY					IMPLEMENTATION						
Code No.	Name of River Basin	Region	Province	Catch. A. (sq. km.)	RIVER DESCRIPTION		Agency	Year	Type	Title/Scope	Status	Agency	Year	Project Description	Status	Study/ Agency	Implementation Phase/Package	Priority
					Section	Feature												
1	Mt. Pinatubo	III	Zambales		Pasig-Potrero	Lahar	1976-78	M/P	MP/FS		Completed	T.S.-YL	1997-		On-going			-
			Pampanga		Sacobia-Bamban		1992-95	F/S			Completed	23-YL	2000-		On-going			
			Tarlac		West Side	Lahar										JICA-FS		A
2	Dalton Pass	II, III	Abra														FSEC Pilot Area	A
3	Mayon	V	Camarines Sur		Mt. Mayon	mudflow lavaflow	JICA	1978-81	M/P	Sabo-FC	Completed						25-YL	A
							JICA	1982-83	M/P	Updating	Completed							
							JICA	1998-00	F/S	Comp. Disas. Prevention	On-going							
4	Ormoc City FC Project	VII	Ormoc City	25.2	anilao River		JICA	1993-95	MP/FS	Flood Control	Completed	GOJ/GA	1998-	River Improvement slit dams, bridges	Completed			-
				11.1	Malbasag River													
5	Iloilo City FC Project	VI	Iloilo City	412	Jaro River	Flooding in Urban Area	JICA	1993-95	MP/FS	Flood Control	Completed	25-YL	2002	River Input Flood Control	On-going		25-YL	A
				106	Iloilo River		22-YL	1999-	D/D	Jaro FW	Completed							

3.3 Solutions implemented / to be implemented :

The following are being pursued to address the key problems identified, to wit :

- Urban development within confines of river waterway and flood plain (both LWC & HWC).
  - Establishment and strict enforcement of local Government zoning regulations
- Deafforestation and resulting increased sediment runoff into river system.
  - Strict enforcement of logging bans through appropriate regulatory agencies – DENR, Police, etc.
  - Implementation of tree planting programs in river watershed areas.
- Philippine is a Volcanic region and the associated impacts of eruptions on river system.
  - Difficult to prepare for in terms of river system due to the magnitude of the event.
  - Post eruption activities very important such as :
    * Dike heightening
    * River channel dredging
    * Sabo dam construction
    * Replacement of damaged infrastructure e.g. bridges
- Philippine is in an earthquake region and the impacts of earthquakes on existing flood control.
  - Ensuring earthquake resistant designs are prepared for new / or replacement river flood control facilities.
- Lower prioritization of flood control projects in the Philippines compared to projects in other sectors.
  - Upgrade priority level of flood control.
  - Enhance in-house capability of DPWH through training and transfer of technology.

WATER RESOURCES AND RIVER MANAGEMENT FOR SUSTAINABLE DEVELOPMENT

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Natural Condition

- The Philippines is an archipelago comprised of 7,100 islands
- It is bounded in the west and north by the South China Sea, on the east by the Pacific Ocean, and the south by the Celebes Sea and the coastal waters of Borneo
- Its total land area is about 300,000 km^2
- It is divided into 3 major island groups, namely:
  - Luzon (141,000 km^2)
  - Mindanao (102,000 km^2)
  - Visayas (57,000 km^2)

Natural Condition (cont'd)

Climate

- The Philippine climate is tropical and maritime
- It is relatively hot, humid, and rainy
- It has two distinct seasons:
  - Rainy Season
  - Dry Season

Natural Condition (cont'd)

Climate (cont'd)

- It has 4 climate types based on rainfall distribution:
  - Type I – Two pronounced seasons, wet (June to November) and dry (December to May)
  - Type II – No dry season with a very pronounced maximum rainfall (December, January, and February)
  - Type III – Unpronounced seasons, relatively dry (November to April) and relatively wet (the rest of the year)
  - Type IV – Rainfall more or less distributed throughout the year

Natural Condition (cont'd)
Rainfall

- Rainfall runs the gamut of intensities
  - The highest is 9,006 mm (Baguio City, 1910)
  - The lowest is 94.2 mm (Vigan, Ilocos Sur, 1948)
  - The average precipitation is 2,360 mm per year
  - It is influenced by:
    - Prevailing streams or monsoons
    - Tropical typhoons
    - The Intertropical Convergence Zone
    - Easterly waves
    - Local thunderstorms
    - Topography

Water Resources

- The Philippines is blessed with abundant water resources
  - The mean rainfall reaches 2,360 mm/yr
  - 421 rivers
  - 59 inland lakes
  - Numerous streams
  - Swamps
  - Marshes

Water Resources (cont'd)

- The Philippines was divided into 12 water resource regions (WRR) by the then National Water Resource Council (NWRC), now the National Water Resources Board (NWRB) in consideration of hydrological water boundaries they are:
  - WRR I – Ilocos Region
  - WRR II – Cagayan Valley
  - WRR III – Central Luzon

Water Resources (cont'd)

- 12 Water Resource Regions (WRR) (cont'd):
  - WRR IV – Southern Tagalog
  - WRR V – Bicol
  - WRR VI – Western Visayas
  - WRR VII – Central Visayas
  - WRR VIII – Eastern Visayas
  - WRR IX – Southwestern Mindaao
  - WRR X – Northern Mindanao
  - WRR XI – Southeastern Mindanao
  - WRR XII – Southern Mindanao

Water Resources (cont'd)

Principal / Major River Basins

- 421 river basins
- Drainage areas range from 41 km^2 to 25,649 km^2
- 60% of river basins have drainage areas ranging from 100 km^2 to 500 km^2
- 20 major rivers with catchment areas exceeding 1,000 km^2
- Cagayan River is the largest at 25,649 km^2

Major River Basins (nos. 1 to 10)

Table 2.1a

No.	River System	Region	Catchment Area (km^2)	River Length (km)
1	Cagayan	Cagayan Valley	25,649	505
2	Mindanao	Southern Mindanao	23,169	373
3	Agusan	CARAGA	10,921	350
4	Pampanga	Central Luzon	9,759	260
5	Agno	Central Luzon	5,952	206
6	Abra	Ilocos	5,125	178
7	Pasig-Marikina-Laguna de Bay	NCR. Southern Tagalog	4,678	78
8	Bicol	Bicol	3,771	136
9	Abulug	Cagayan Valley	3,372	175
10	Tagum-Libuganon	Southeastern Mindanao	3,064	89

Major River Basins (nos. 11-20)

Table 2.1b

No.	River System	Region	Catchment Area (km^2)	River Length (km)
11	Ilog-Hilabangan	Western Visayas	1,945	124
12	Panay	Western Visayas	1,843	132
13	Tagaloan	Northern Mindanao	1,704	106
14	Agus	Southern Mindanao	1,645	36
15	Davao	Southeastern Mindanao	1,623	150
16	Cagayan de Oro	Northern Mindanao	1,521	90
17	Jalaur	Western Visayas	1,503	123
18	Buayan-Malungun	Southeastern Mindanao	1,434	60
19	Laoag	Ilocos	1,353	73
20	Amnay-Patrick	Southern Tagalog	993	58

Major River Basins (cont'd)

- Rivers are commonly **short** and **steep**
- Most of the major rivers have channel gradients that range from 0.40% to 0.70%
- However, the two largest, the Cagayan and Cotabato rivers have channel gradients of 0.08% and 0.13%, respectively

Water Resources

Groundwater Resources

- The Philippines has extensive groundwater resources.
- It has an estimated storage capacity of 1.22 M cubic meters. The four major reservoirs are:
  - Angat
  - Magat
  - Ambuklao
  - Pantabangan

Water Problems

Flood Disasters

The Philippines is one of the most disaster-prone countries due to frequent typhoons and floods

- Its location and meteorological condition make it vulnerable to flood disasters
- It lies along the path of an average of **20** tropical cyclones yearly
- 9 of which directly affect the mainland and cause enormous damage to lives and property
- Damages to property, agriculture, infrastructure, and death or injury to people

Water Problems

Flood Disasters (cont'd)

- Flood disasters are due to the progressive deterioration of of rivers and streams in the flood plains and delta areas
- This results from the lack of flood control facilities, inappropriate or antiquated technology, budgetary constraints, inadequate river administration, and encroachment of natural channels

Water Problems

Sediment Disasters

- The Philippines has been experiencing sediment disasters due to its geographical conditions
  - It lies on several fault lines
  - There are 22 active volcanoes
- Sediment-related disasters often occur due to sediment movement (i.e. debris flow, slope failure, landslides, volcanic mudflow)

Water Problems

Sediment Disasters (cont'd)

- Man's activities have also contributed to the problem, such as:
  - Severe deforestation due to illegal logging resulting in easy sedimentation and debris flow amounting to riverbed aggradations, and severe flooding.
- The implementation of the appropriate measures are also hampered by the following factors:
  - Budget constraints
  - It is of low priority
  - Lack of appropriate technology

Water Problems

Water Shortages

- Although the Philippines is considered a water-rich country, there are some areas in the country which experience water shortages.
- The demand for potable water is far from being met by the supply provided by water utilities, both public and private in nature.

Water Problems

Water Shortages (cont'd)

- In a Master Plan Study in Water Resources and Management in 1998, 4 water resource regions were found to be in critical condition due to the small ratios of water resources potential to total water demand in 2025. They are the following:
  - WRR II
  - WRR III
  - WRR IV
  - WRR VII

Water Problems

Water Shortages (cont'd)

- The water scarcity problem is caused by the following:
  - Increasing population
  - Growing urbanization
  - Increasing demand
  - Watershed degradation that endangers the capacity of the natural ecosystem to sustain water
  - Water pollution
  - The growing cost of water dev't. under shortages
  - Water allocation among competing uses (domestic, irrigation, industrial and commercial, and hydropower)

Water Problems

Water Contamination and Damage to the Ecosystem

- 50 out of the 421 rivers in the country, including the four major rivers in Metro Manila are already considered biologically dead due to the indiscriminate dumping of raw sewage.
- Water quality degradation is attributed to various practices that pollute the environment, such as:
  - Direct waste dumping by domestic and industrial sources
  - Sedimentation by logging-induced soil erosion
  - Siltation by mining
  - Other ecologically-disturbing agricultural practices

Other Water-Related Problems

- Groundwater exploitation has resulted in saline water-intrusion problems
- Metro Manila and Metro Cebu has been experiencing such problems
- Exploitation of groundwater is the common cause of this problem
- Another problem is the contamination of groundwater brought about by domestic sewage, factory waste, and agricultural chemicals.

Government Efforts

- The importance of water resources and river management for sustainable development is recognized by the government
- Sustainable development has been defined as three-dimensional:
  - Economic
  - Social
  - Environmental

Government Efforts (cont'd)

- It is also supported by growth with equity, people empowerment, and the maintenance of ecological integrity.
- The Philippine Agenda 21 defines the action and intervention strategies at the ecosystem level.
- Among the identified ecosystems and critical resources are:
  - Freshwater ecosystem
  - Coastal / Marine Ecosystem