THE REPUBLIC OF THE PHILIPPINES

THE FEASIBILITY STUDY
ON
THE DEVELOPMENT PROJECT
ON
THE METEOROLOGICAL TELECOMMUNICATION SYSTEM

FINAL REPORT
SUMMARY

JANUARY 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

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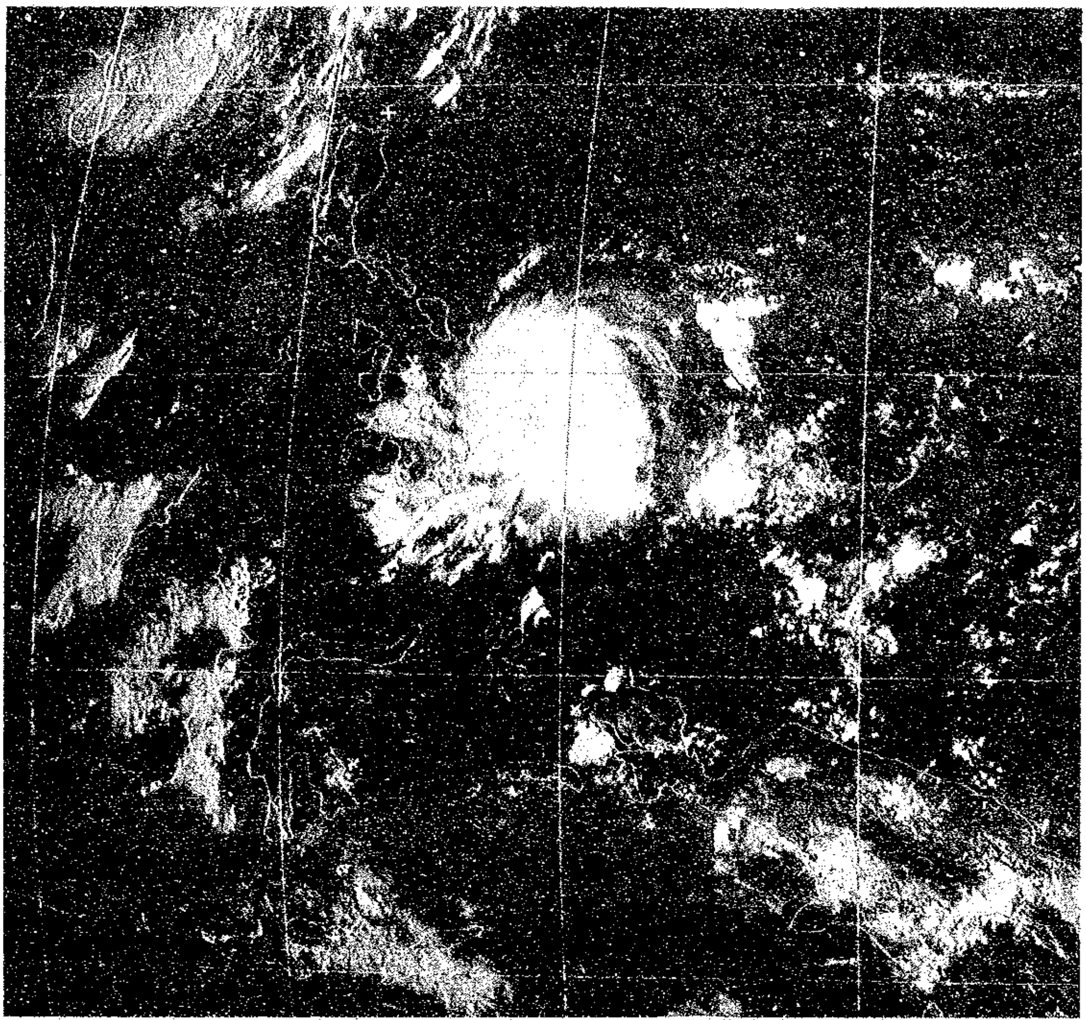


Photograph of Geostational Meteorological Satellite

Typhoon NITANG (8411), (1st. Sept. 1984 00Z)

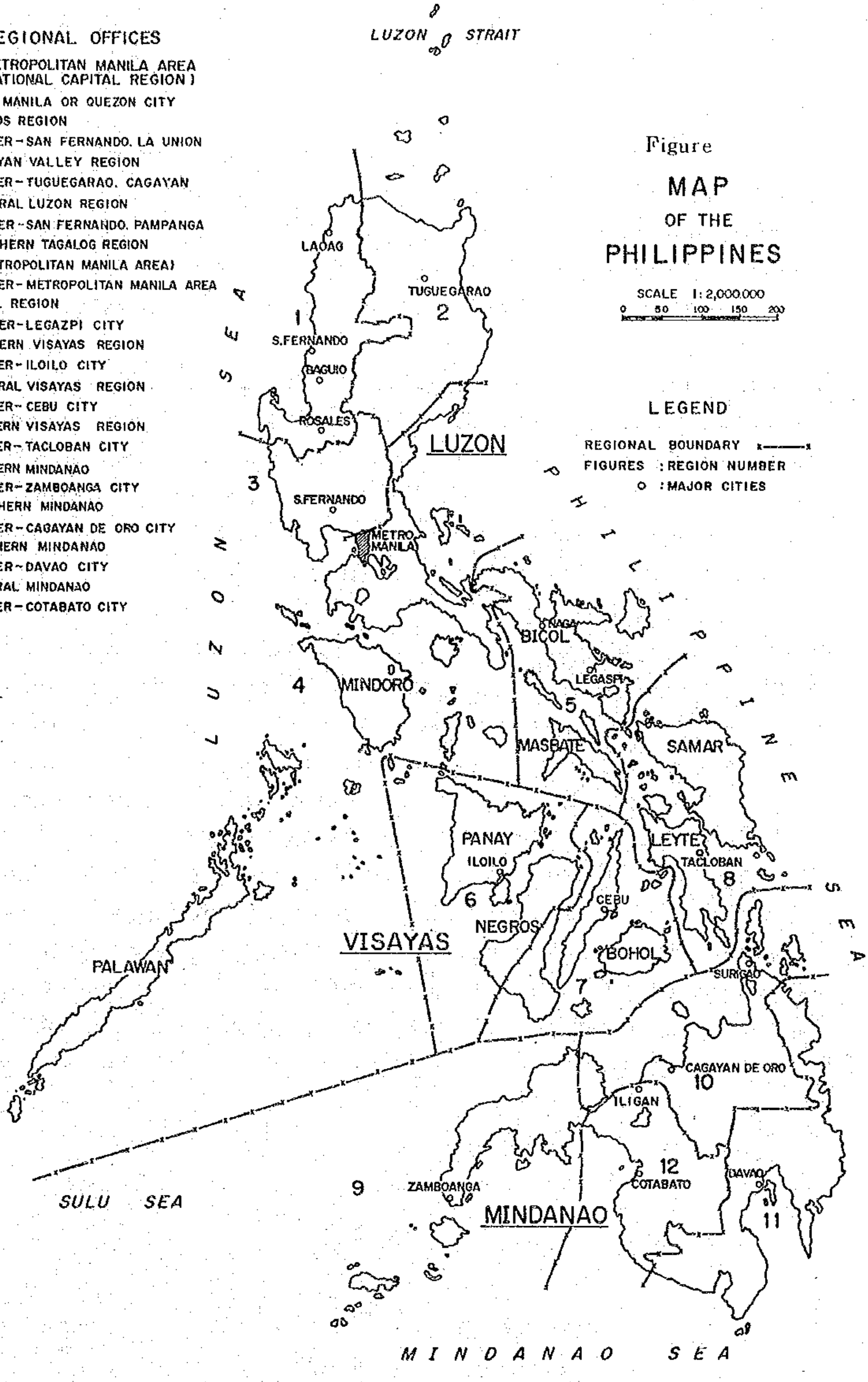
REGIONAL OFFICES

METROPOLITAN MANILA AREA
(NATIONAL CAPITAL REGION)

REGIONAL CENTER – MANILA OR QUEZON CITY
REGION No. 1 – ILOCOS REGION
    REGIONAL CENTER – SAN FERNANDO, LA UNION
REGION No. 2 – CAGAYAN VALLEY REGION
    REGIONAL CENTER – TUGUEGARAO, CAGAYAN
REGION No. 3 – CENTRAL LUZON REGION
    REGIONAL CENTER – SAN FERNANDO, PAMPANGA
REGION No. 4 – SOUTHERN TAGALOG REGION
    (EXCLUDING METROPOLITAN MANILA AREA)
    REGIONAL CENTER – METROPOLITAN MANILA AREA
REGION No. 5 – BICOL REGION
    REGIONAL CENTER – LEGAZPI CITY
REGION No. 6 – WESTERN VISAYAS REGION
    REGIONAL CENTER – ILOILO CITY
REGION No. 7 – CENTRAL VISAYAS REGION
    REGIONAL CENTER – CEBU CITY
REGION No. 8 – EASTERN VISAYAS REGION
    REGIONAL CENTER – TACLOBAN CITY
REGION No. 9 WESTERN MINDANAO
    REGIONAL CENTER – ZAMBOANGA CITY
REGION No. 10 – NORTHERN MINDANAO
    REGIONAL CENTER – CAGAYAN DE ORO CITY
REGION No. 11 SOUTHERN MINDANAO
    REGIONAL CENTER – DAVAO CITY
REGION No. 12 CENTRAL MINDANAO
    REGIONAL CENTER – COTABATO CITY

Figure

MAP OF THE PHILIPPINES



PREFACE

In response to the request of the Government of the Republic of the Philippines, the Government of Japan decided to conduct a feasibility study on the Development Project of the Meteorological Telecommunication System and entrusted the study to the Japan International Co-operation Agency (JICA).

The JICA sent to the Philippines a study team headed by Dr. Eizou MARUYAMA, expert, Meteorological Institute of Japan Weather Association, in September 1983, under the guidance of the advisory committee chaired by Mr. Mitsuo NARUI, director of the radio communication division, forecast department, Japan Meteorological Agency.

The team held discussion with the authorities concerned of the Government of the Philippines on the project and field survey in the country. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will be served for the development of the project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the authorities concerned of the Government of the Republic of the Philippines for their close cooperation extended to the team.

January 1985

Keisuke Arita

Keisuke ARITA
President
Japan International Cooperation Agency

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SUMMARY

1. Background of the Project

The Republic of the Philippines, being located between 4° and 21° north latitudes in the West Pacific, is affected by typhoons and monsoons every year. The damage amount in terms of loss of human lives and in properties is enormous every year. In 1970, for example the number of casualties, including death and missing caused by typhoon amounted to as many as 1,820 and in 1978, to 1,050.

Under such circumstances, the government of the Philippines requested the government of Japan to carry out a feasibility study (the Study) on the improvement of the meteorological telecommunication system (the Project) in June, 1982. In response to this request, the Japan International Cooperation Agency (JICA), the official agency of the government of Japan, dispatched a field study team headed by Dr. Eizo Maruyama in September, 1983. The study team, in accordance with the Implementing Arrangement (I/A) agreed mutually between JICA and Philippine Atmospheric Geophysical and Astronomical Service Administration (PAGASA), the implementing agency of the government of the Philippines, conducted a field study from the end of September, 1983 to the end of March, 1984. The analysis and evaluation work has been continued thereafter in Japan. The present report is the Final Report in which the result of the Study is compiled.

2. Scope of the Study

The site survey was carried out all over the Philippines, including the Luzon, visayas and Mindanao regions.

The Study covered the following major items:

(1) Radio wave propagation test of the meteorological telecommunication system (OH, VHF, HF) and its preliminary design

(2) Analysis and evaluation of the collected data

(3) Survey and preliminary design of the meteorological observing facilities and stand-by power facilities

(4) Preliminary design of the dissemination system of meteorological information

(5) Operation and maintenance plan

(6) Evaluation of the Project

(7) Cost estimate and implementation plan

3. Present Situation of Meteorological Services and its Problems

The following conditions are generally required in order to perform meteorological services satisfactorily.

① To collect precise observational data quickly at the Centers.

② To disseminate the collected data rapidly from the Centers to the subordinate weather stations.

③ To process and analyze the collected data at the forecast centers.

④ To disseminate observational data and processed information quickly from the appropriate centers to the subordinate weather stations.

However, some problems described below can be found on the basis of the results of investigation on the present situation of the Philippines.

3.1 Present Situation of Meteorological Services

The meteorological observations relating to surface and upper air observations, weather radar observations, and seismological and oceanographical observations are being carried out.

Concerning the meteorological telecommunication, only one radio telephone link (SSB : Single Side Band) is used as

a means of telecommunication between the PAGASA Forecast Center (PFC) and weather stations to collect observed data and disseminate various meteorological information.

As to the weather forecast services, the analyses of collected data are carried out in the PFC in order to disseminate the weather forecasts for the whole country and regions to its related organizations.

PAGASA weather station's location is shown in Fig. 1.

3.2 Problems on Meteorological Services

3.2.1 Meteorological Observations

(1) Most of the observation instruments used are obsolete, which may not result in accurate readings.

(2) In the training of weather observers it is required to introduce modern and/or automated techniques.

3.2.2 Telecommunication operation

(1) Means of telecommunication (surface observation, radar observation, seismological observation) rely only on SSB. Telecommunicational problems sometimes occur, due to the interference, and restricted time, and outages.

(2) Facilities are obsolete and the telecommunication network is not systematically organized.

(3) The spare parts required for repair are no longer manufactured.

3.2.3 Weather Forecast

The collection rate of national weather data necessary for making weather forecasts is not adequate. It is necessary to collect much more weather data to improve the accuracy of weather forecasts.

3.2.4 Stand-by Power Supply

Interruption of commercial power supply frequently occurs. Moreover, the stand-by power supply has become outmodeled and aged. Therefore, it always affects the smooth operation of meteorological services throughout year.

4. The Project

Based on the result of the analyses and evaluation of the collected data, it is planned in this study to establish the meteorological telecommunication system (MTS) summarized hereunder.

4.1 Overall System

The overall system of the meteorological telecommunication is depicted in Fig.2. The overall system consists of the telecommunication lines of main trunk and branch lines connecting 64 weather stations in the whole country. It has such functions as sending weather data from the weather stations to the PFC and as disseminating weather information from the PFC to each weather station after processing and analyzing.

The main trunk line extends about 1,300 km from TUGUEGARAO in Northern Luzon to CAGAYAN DE ORO in Mindanao by which the PFC, SCIENCE GARDEN, 3 Data Collection Centers (DCC), 3 Data Relay Stations (DRS) and 8 weather stations are connected.

The PFC in this system performs the functions as the center of the collection and dissemination of all the weather data and information throughout the country. A mini-computer to be installed at the PFC will process and analyze the weather data.

Both DCC and DRS are the relaying stations at which weather data in the related regions are collected and through which weather information is disseminated. DCC

has its own permanent operators, while DRS has no operators and is automated.

The telecommunication line of the Flood Forecasting and Warning system (FFWS) installed between TUGUEGARAO in Northern Luzon and NAGA in the Bical region is planned to be utilized in common by MTS (meteorological telecommunication system) in this Study. Therefore, a new installed line will be established between NAGA in the Bical region and CAGAYAN DE ORO in Mindanao.

4.2 Main Trunk Line

The main trunk line extends from TUGUEGARAO to CAGAYAN DE ORO via Manila connecting the following stations:

		(remarks)
TUGEUGARAO	(DCC)	
CARMEN ROSALES	(DRS)	
SCIENCE GARDEN		
PFC	(MCC)	
TANAY	(DRS)	
GAPAS		
NAGA		
MALABOG		LEGASPI (DRS)
BALOD		CATARMAN
CARACUAN	(Passive relay site)	
TINAMBACAN		
DANAO		MACTAN RADAR (DCC)
MALASAG		
CAGAYAN DE ORO	(DCC)	

The Main trunk line constitutes a multiplex over horizon (OH) telecommunication with 800 MHz in principle and consists of data transmission channel and telephone channel which is commonly used for facsimile transmission. Both channels operate on a full duplex basis. Trunking Plan is shown in Fig. 3.

4.3 Branch Line Network

The branch line network links with DCC, DRS and SCIENCE GARDEN directly. The radio frequencies to be used by branch lines are the VHF band with 150 MHz and the HF band (SSB).

The VHF link has the function of the full duplex telecommunication and moreover, each terminal station will have two independent radio frequencies: one is for data transmission and another for telephone channel commonly used for facsimile transmission.

The HF link has the function of the simplex telecommunication by SSB. However, the teletype equipment with ARQ to be installed will make the HF network semi-duplex telecommunication when the data transmission will be made in digital form.

4.4 Telecommunication Control System

A mini-computer system with one stand-by computer will be installed at the PFC to control the data transmission of the main trunk line. The stand-by computer will be used to process the observed data from each weather station

and compile statistic data such as monthly and annual reports.

4.5 Stand-by Power Generators

Commercial power will be used at all the stations with main trunk lines, which operate for 24 hours a day. A stand-by power generator will be installed in case of commercial power interruption and it is possible to shift automatically from a commercial power supply to the generator.

The stations on the branch line network usually do not operate for 24 hours a day. Where the commercial power is not available, a self-generator or batteries will be the power source in branch line network stations. A solar cell system is planned at two sites; one is AMPUCAO and another is ROMBULON island.

4.6 Observation Equipment

There are many obsolete meteorological equipments which have to be replaced and PAGASA desires strongly their replacement. In this Study, about one third of the whole meteorological equipment are approximately planned to be replaced; they include wind vane and annemometers, self-recording rain gauges, psychrometers, pyranometer, Fortin barometers, and panzer masts and other associated instruments.

4.7 Operation System

Main Communication Center (MCC) at the PFC: The Center will be operated for 24 hours a day. Therefore, there are 13 persons required in total with a supervisor and with 4 groups (3 operators in each group) under 3-shift-a-day system will be required. The composition of the above 3 operators will be 2 communication operators and one computer operator for communication control.

DCC and SCIENCE GARDEN: These stations will be operated for 24 hours a day. Therefore, 9 persons with a chief and with 4 groups (2 operators in each group) under 3-shift-a-day system will be required.

Other stations other than the above: 5 persons with a chief and with 4 groups (one person for each group) under 3-shift-a-day system will be required. However, these operators will be also in charge of meteorological observation.

4.8 Maintenance System

For the maintenance of meteorological telecommunication equipment, it may be required to intensify the maintenance and repairing services. Therefore, a maintenance center must be installed at DILIMAN.

In the PFC, DCC and DRS (except TANAY), technicians in charge of the maintenance and small-scale repairing at these stations will be assigned. Measuring instruments, spare parts and materials and tools will be provided for maintenance services of various equipment. Service cars for maintenance patrol will be stationed in these stations.

5. Cost Estimation and Implementation Plan

For the implementation plan, two alternative plans are considered. The duration of implementation for each plan is three years. In plan 1, emphasis is put on the geographical condition, and plan 2 on the function of telecommunication.

Taking into consideration the results of comparison of both plans, plan 1 is desired to be carried out.

The implementation plan for three years, including construction costs, is summarized in Table 1, (1/3) - (3/3).

Table 1 (1/3)

1st Plan

Cost Estimation

Unit: ₽10³

Items	1st Year		2nd Year		3rd Year		Total	
	*1 F	*1 L	F	L	F	L	F	L
OH equipment	31,016		34,011				65,027	
Improvement of OH equipment			3,548				3,548	
VHF equipment	15,000				2,646		17,646	
HF equipment					9,128		9,128	
FAX equipment					3,412		3,412	
Peripheral or ARQ	6,884		395		9,052		16,331	
Mini computer	32,009		13,252				45,261	
Stand-by power supply	5,728		7,301		849		13,878	
Installation cost for all the aboves			18,860	333	22,459	395	41,319	728
Transportation cost for all the aboves	1,890			213	2,204	325	4,094	538
Antenna tower *2	1,818		4,454	908		2,852	6,272	3,760
Commercial power		987		1,911				2,898
Station building		2,957		4,048				7,005
Access road		2,617		4,363				6,980
Meteorological instrument *2	7,183	190					7,183	190
Total	101,528	6,751	81,821	11,776	49,750	3,572	233,099	22,099
Engineering & Administration	10,152	675	8,182	1,178	4,975	357	23,309	2,210
Physical contingency	10,152	675	8,182	1,178	4,975	357	23,309	2,210
Sub Total	121,832	8,101	98,185	14,132	59,700	4,286	279,717	26,519
Price contingency	4,922	2,612	6,010	7,361	4,921	3,210	15,853	13,183
Grand Total	126,754	10,713	104,195	21,493	64,621	7,496	295,570	39,702
Grand Total	137,467		125,688		72,117		335,272	

Notes: *1 F: Foreign currency portion, L: Local currency portion
*2 Including installation and transportation cost.

Table 1 (2/3)

Luzon Area

Unit: ₱10^3

Items	1st Year		2nd Year		3rd Year		Total	
	*1 F	*1 L	F	L	F	L	F	L
OH equipment	31,016						31,016	
Improvement of OH equipment			3,548				3,548	
VHF equipment	15,000						15,000	
HF equipment					3,260		3,260	
FAX equipment					2,881		2,881	
Peripheral or ARQ	6,884				2,881		9,765	
Mini computer	32,009		11,372				43,381	
Stand-by power supply	5,728				243		5,971	
Installation cost for all the aboves			18,860	333	2,545	24	21,405	357
Transportation cost for all the aboves	1,890			213	190	68	2,080	281
Antenna tower *2	1,818			908			1,818	908
Commercial power		987						987
Station building		2,957		1,091				4,048
Access road		2,617						2,617
Meteorological instrument *2	4,789	127					4,789	127
Total	99,134	6,688	33,780	2,545	12,000	92	144,914	9,325
Engineering & Administration	9,913	669	3,378	255	1,200	9	14,491	933
Physical contingency	9,913	669	3,378	255	1,200	9	14,491	933
Sub Total	118,960	8,026	40,536	3,055	14,400	110	173,896	11,191
Price contingency	4,806	2,588	2,481	1,591	1,187	82	8,474	4,261
Grand Total	123,766	10,614	43,017	4,646	15,587	192	182,370	15,452
Grand Total	134,380		47,663		15,779		197,822	

Notes: *1 F: Foreign currency portion, L: Local currency portion
*2 Including installation and transportation cost.

Table 1 (3/3)

Visayas and Mindanao Area

Unit: ₱10³

Items	1st Year		2nd Year		3rd Year		Total	
	*1 F	*1 L	F	L	F	L	F	L
OH equipment			34,011				34,011	
Improvement of OH equipment							-	
VHF equipment					2,646		2,646	
HF equipment					5,868		5,868	
FAX equipment					531		531	
Peripheral or ARQ			395		6,171		6,566	
Mini computer			1,880				1,880	
Stand-by power supply			7,301		606		7,907	
Installation cost for all the aboves					19,914	371	19,914	371
Transportation cost for all the aboves					2,014	257	2,014	257
Antenna tower *2			4,454			2,852	4,454	2,852
Commercial power				1,911				1,911
Station building				2,957				2,957
Access road				4,363				4,363
Meteorological instrument *2	2,394	63					2,394	63
Total	2,394	63	48,041	9,231	37,750	3,480	88,185	12,774
Engineering & Administration	239	6	4,804	923	3,775	348	8,818	1,277
Physical contingency	239	6	4,804	923	3,775	348	8,818	1,277
Sub Total	2,872	75	57,649	11,077	45,300	4,176	105,821	15,328
Price contingency	116	24	3,529	5,770	3,734	3,128	7,379	8,922
Grand Total	2,988	99	61,178	16,847	49,034	7,304	113,200	24,250
Grand Total	3,087		78,025		56,338		137,450	

Notes: *1 F: Foreign currency portion, L: Local currency portion
*2 Including installation and transportation cost.

6. Evaluation of the Project

As the benefit of the Project, the future mitigation of typhoon damage was adopted and estimated through the principle of Delfi Method; future mitigation of typhoon damage was anticipated by 7 experienced personnels responsible for natural disaster prevention through filling the identical questionnaire on future typhoon damage mitigation three times. Individual estimation was amended by taking into consideration the other personnels' estimation each time and finally convergent answers were obtained. As the result, 17.4% of the present typhoon damage was anticipated to be mitigated. It is noted, however, that the above typhoon damage mitigation can be realized as an integrated effect of dam construction, FFWS and MTS.

Since the proportion of the MTS's contribution toward the typhoon damage mitigation is not distinguished, a mitigation ratio by which the estimated benefit becomes equal to the cost of the Project was sought based on Table 2 and the mitigation ratio of 1.7% was derived.

Meanwhile, a study presented in the planning report of WMO (Thompson's study) indicates that, as a result of scientific progress and operational improvement in weather information, 5% of the present damage and losses caused by adverse weather can be mitigated.

Although nothing can be stated on the proportion of individual contribution of dam, FFWS and MTS toward mitigation of typhoon damage, the contribution of the Project toward mitigation of typhoon damage could be

estimated to be more than 1.7% when the mitigation ratio of 5% which is indicated in the above Thompson's study is referred to. When the fact that the above benefit was estimated based on a portion of the whole conceivable benefit of the Project is considered, the real contribution of the Project toward the mitigation of typhoon damage may be estimated to be more than 1.7%. From these contexts, it may be moderate to state that the B/C ratio of the Project is estimated to be more than unity.

7. Conclusion

The technical aspects of the Project was studied and the conceived meteorological telecommunication system comprising the OH main trunk, VHF and HF branch networks connected to each of 64 weather stations has been found technically sound.

The economic feasibility was examined through reviewing the estimated benefit of the Project and it was inferred that the benefit of the Project would exceed the cost of the Project.

Apart from the benefit-cost comparison, it is to be noted that the improvement of meteorological telecommunication system will bring significant effects on many fields of economic activities such as agriculture, fishery, railway, road transport, aviation, navigation and power industry. Mitigation of typhoon damage to housings and buildings can also be expected. The decrease in casualties may be, among others, the biggest effect of the Project.

Actually, more than 1,000 human lives had been lost due to a destructive typhoon (Typhoon Nitang : September 1984). Besides the domestic contribution, the Project is expected to promote the development of meteorological services in the neighboring countries of the Philippines. Judging from its extensive and significant effects, though they are not fully quantified, to the socio-economy of the whole Philippines, the improvement of meteorological telecommunication system is urgently recommended to be implemented.

PAGASA WEATHER STATION'S LOCATION

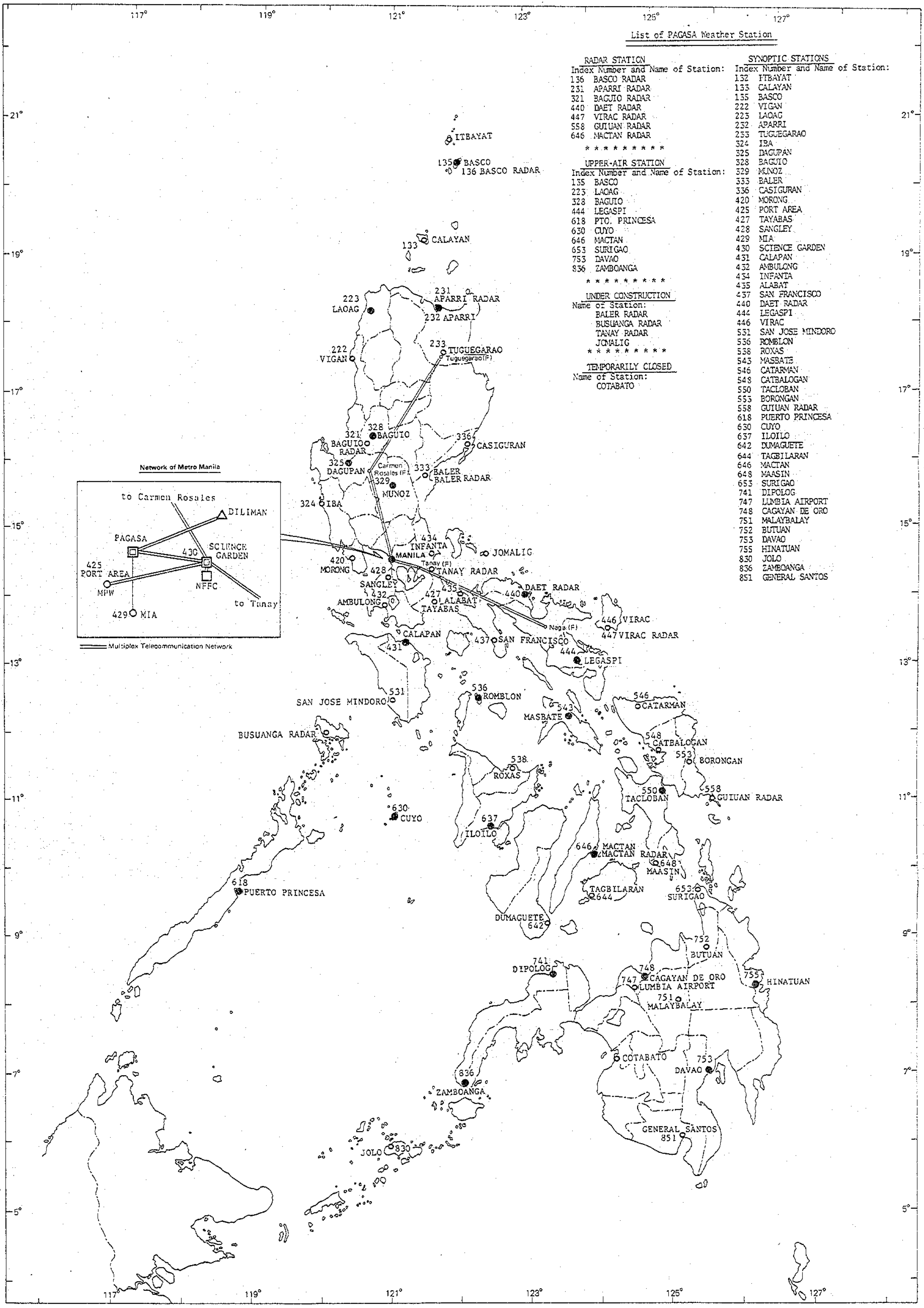

Fig. 1

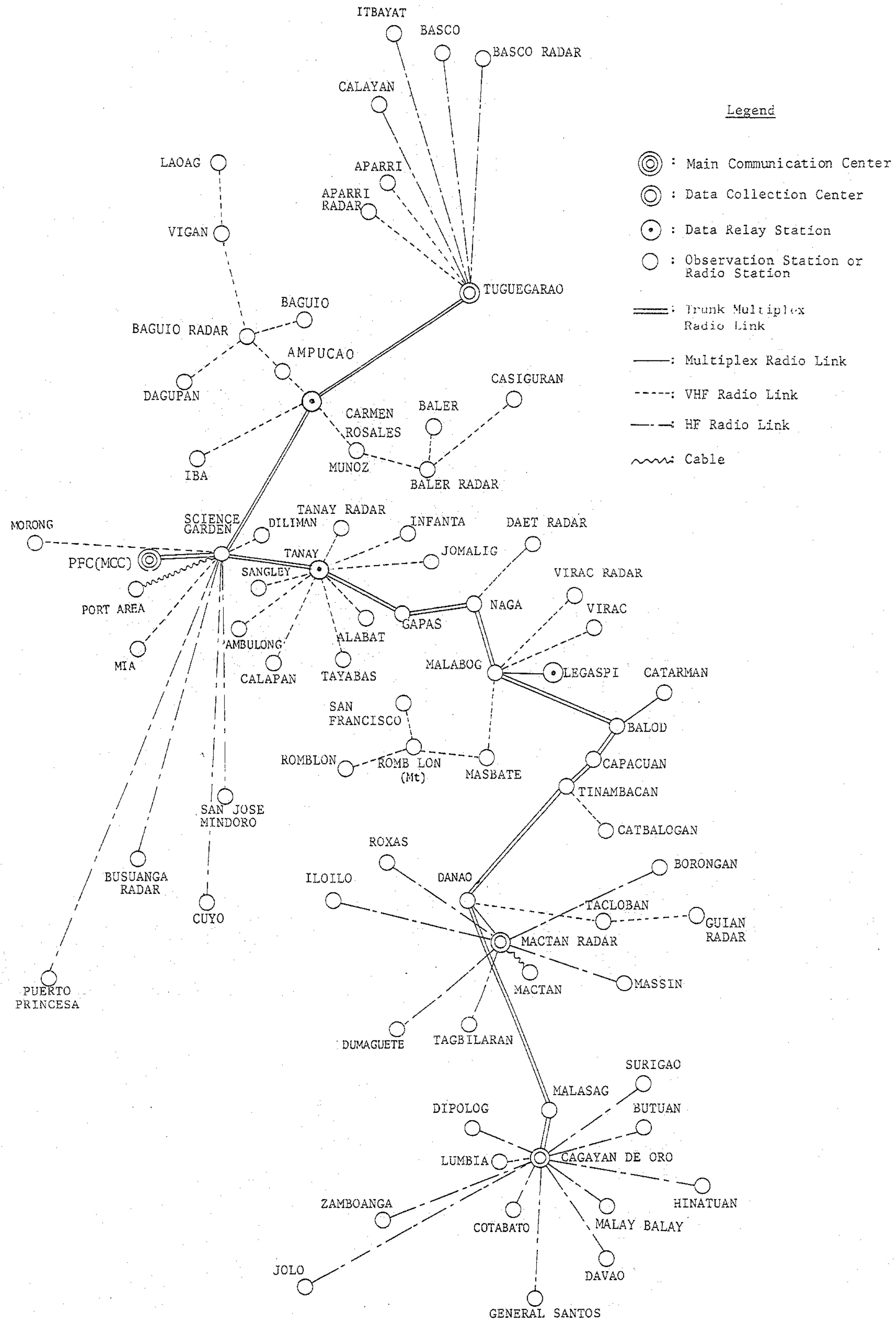

Fig. 2 Meteorological Radio Communication System

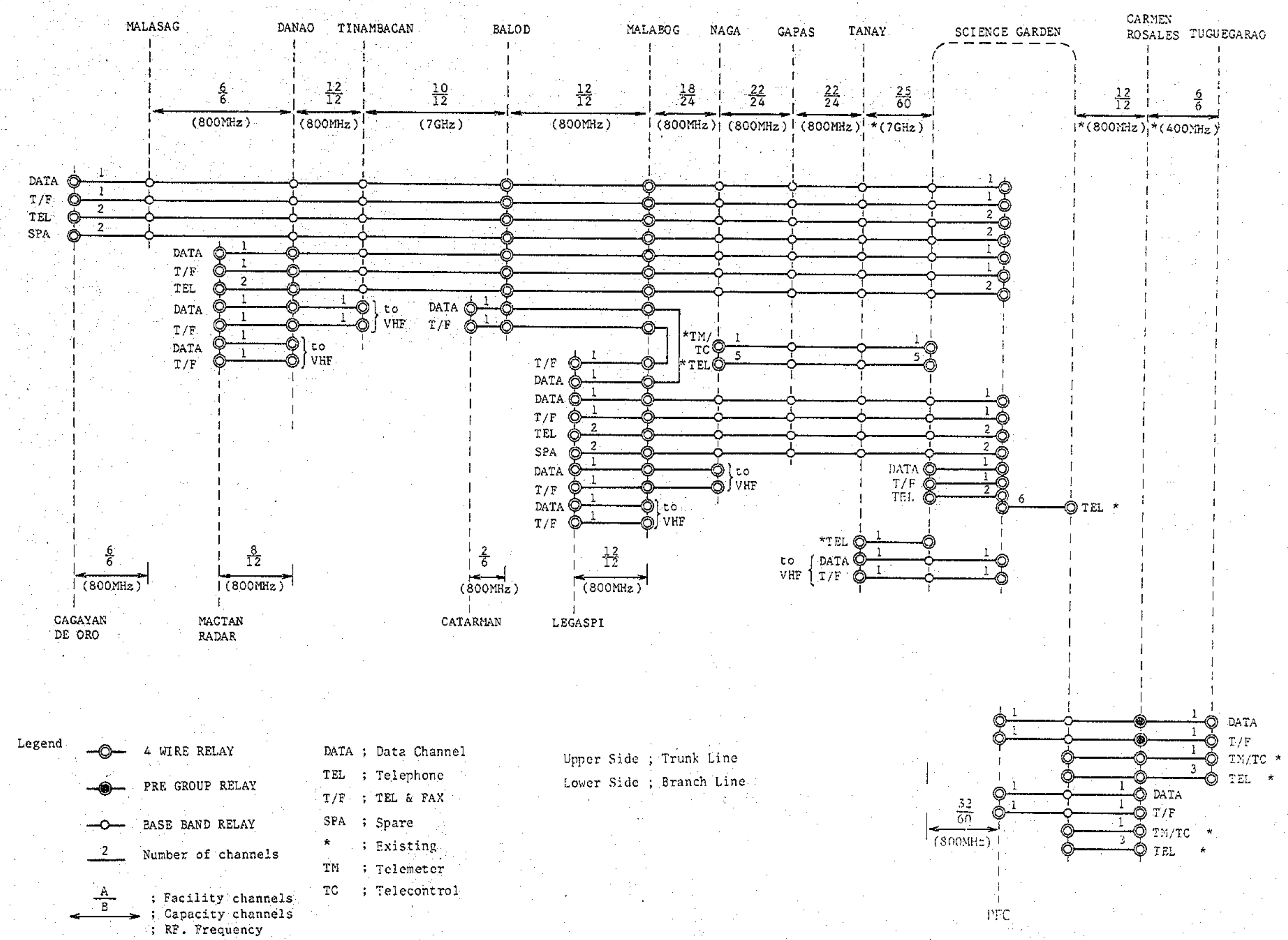

Fig. 3 Trunking Plan

Table 2 Derivation of Typhoon Damage Mitigation Ratio to Equalize the Benefit of the Project to the Cost of the Projec (For Plan 1)

(Unit: ₱10^6)

No.	Year	Costs			Total Benefit
		Capital Cost & Replacement Cost	O&M Cost	Total Cost	
1.	1986	130.0	-	130.0	-
2.	87	112.0	-	112.0	-
3.	88	64.0	3.9	67.9	420.0
4.	89	0	6.2	6.2	790.0
5.	90	0	6.2	6.2	1,160.0
6.	91	0	6.2	6.2	1,530.0
7.	92	0	6.2	6.2	1,900.0
8.	93	0	6.2	6.2	2,270.0
9.	94	0	6.2	6.2	2,640.0
10.	95	0	6.2	6.2	3,010.0
11.	96	0	6.2	6.2	3,380.0
12.	97	0	6.2	6.2	3,750.0
13.	98	199.0	6.2	205.2	4,120.0
14.	99	0	6.2	6.2	4,490.0
15.	2000	0	6.2	6.2	4,865.0
16.	01	0	6.2	6.2	4,918.0
17.	02	0	6.2	6.2	4,973.0
18.	03	0	6.2	6.2	5,025.0
19.	04	0	6.2	6.2	5,077.0
20.	05	0	6.2	6.2	5,131.0
21.	06	0	6.2	6.2	5,183.0
22.	07	0	6.2	6.2	5,236.0
23.	08	199.0	6.2	205.2	5,289.0
24.	09	0	6.2	6.2	5,343.0
25.	10	0	6.2	6.2	5,395.0
26.	11	0	6.2	6.2	5,449.0
27.	12	0	6.2	6.2	5,503.0
28.	13	0	6.2	6.2	5,557.0
29.	14	0	6.2	6.2	5,610.0
30.	15	0	6.2	6.2	5,664.0
31.	16	0	6.2	6.2	5,719.0
32.	17	0	6.2	6.2	5,774.0
33.	18	0	6.2	6.2	5,829.0
		704.0	189.9	893.9	131,000.0

Present Worth of Cost = Present Worth of Benefit x X%

$X = \frac{424.1}{25,257.6} = 1.68\%$ (Discount Rate = 10%)