The Study on
Sabo and Flood Control for
Western River Basins of Mount Pinatubo
in
the Republic of the Philippines

Final Report

Volume II
Main Report

September 2003

Nippon Koei Co., Ltd.
CTI Engineering International Co., Ltd.

Japan International Cooperation Agency

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Exchange Rates

US$ 1.0 = Philippine Peso 50.5
US$ 1.0 = Japanese Yen 120.1

Average of July 2002

PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct the Study on Sabo and Flood Control for Western River Basins of Mount Pinatubo and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Shinsuke HINO of Nippon Koei Co., Ltd. (consisting of Nippon Koei Co., Ltd. and CTI Engineering International Co., Ltd.) to the Philippines four times between April 2002 and August 2003. In addition, JICA set up an advisory committee headed by the late Mr. Masaaki NAKANO, Director, Independent Administrative Institution Public Works Research Institute, between April 2002 and August 2003, which examined the study from specialist and technical point of view.

The team held discussions with the officials concerned of the Government of the Philippines and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Philippines for their close cooperation extended to the team.

September 2003

川上隆朗

Takao KAWAKAMI
President
Japan International Cooperation Agency

September 2003

Mr. Takao Kawakami
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

It is a great pleasure that we submit herewith the Final Report of the "Study on Sabo and Flood Control for Western River Basins of Mount Pinatubo in the Republic of the Philippines".

The study has prepared a master plan for sabo and flood control for the western river basins of Mount Pinatubo including the Bucao, Maloma and Sto. Tomas River basins and proposed the priority projects, for which the feasibility study was conducted. The master plan has been formulated combining the structural measures, non-structural measures and community disaster prevention systems with the target year of 2022. The proposed priority projects are heightening and strengthening of the existing dikes in the Bucao and Sto. Tomas River as the structural measures, flood/ mudflow warning and evacuation system as the non-structural measures, and community disaster prevention systems consisting of community-based forest management, agricultural development on lahar area, community road rehabilitation and support programs for the Aeta people.

The report consists of 4 volumes; Volume I for Executive Summary, Volume II for Main Report, Volume III for Supporting Report and Volume IV for Data Book. The report covers all the outcomes of the master planning and feasibility study.

We hope that the report will be helpful for realization of the projects and programs proposed in the study to mitigate the flood/mudflow damages in the downstream and to secure livelihood of the people in the midstream and upstream, and will contribute to the poverty alleviation and socio-economic development of the western river basins.

We wish to express our grateful acknowledgement to the personnel from your Agency in Tokyo and the Philippines, Advisory Committee, Ministry of Foreign Affairs, Ministry of Land, Infrastructure and Transport, Embassy of Japan in the Philippines, and also to officials and individuals of the Government of the Philippines including DPWH for their kind assistance and advice extended to the study team.

Very truly yours,

Shinsuke Hino
Team Leader
The Study on Sabo and Flood Control for
Western River Basins of Mount Pinatubo
in the Republic of the Philippines

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

The Study on Sabo and Flood Control for Western River Basins of Mount Pinatubo in the Republic of the Philippines

JAPAN INTERNATIONAL COOPERATION AGENCY

Location Map of Study Area

Structural
Bucao River
1) Heightening of existing right dike (l=6.7 km) and construction of new dike downstream from the bridge (l=1.9 km on left bank, l=2.4 km on right bank)
2) Reconstruction of Bucao Bridge (355 lm)
3) Observation of hydrological/geological data at Maraunot Notch
<to be included in the warning system>
4) Consolidation dam and sand pocket
<Review>

Non-structural
Evacuation System
1) Increase of 60 evacuation centers
2) Renovation of 32 evacuation centers
3) Dissemination of hazard map

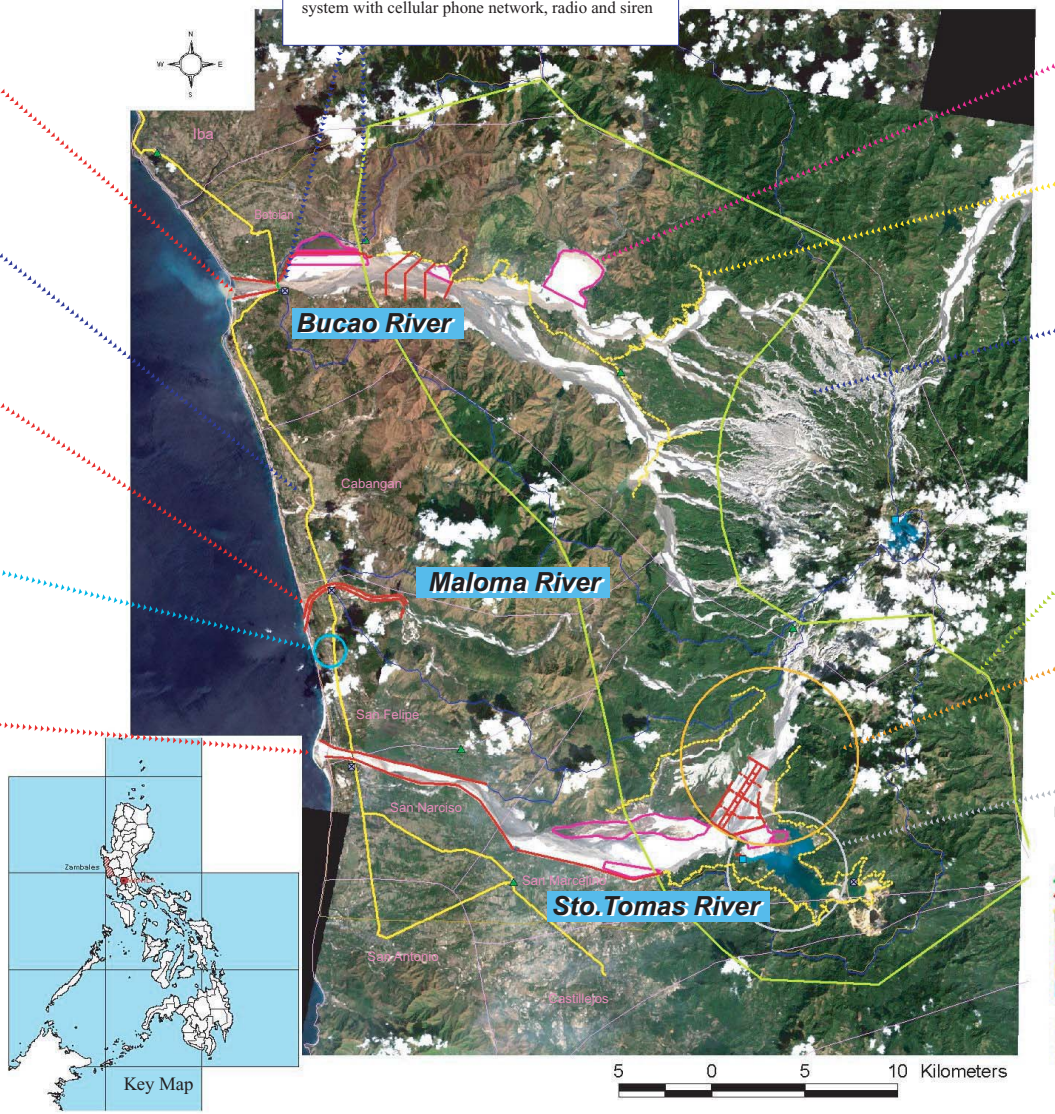
Structural <Review>
Maloma River
1) Channel improvement with straightening, widening and dike heightening/construction (l=7 km)
2) Reconstruction of Maloma Bridge (240 lm)

CDPP *<Further discussion with people in the centers and study are recommended prior to implementation>*

Improvement of Tektek Resettlement Center
Integration of three NGOs resettlement centers in Tektek Resettlement Center and improvement of community infrastructure for improvement of living conditions for the people in the centers

Structural
Sto. Tomas River
1) Heightening of existing dike (l=13.6 km), strengthening of existing dike (l=13.6 km) and construction of new dike (l=2 km) with Gabor River drainage improvement
2) Reconstruction of Maculcol Bridge (430 lm)
3) Consolidation dam/sand pocket/channel works
<Review>

Non-structural
Warning System
7 Rainfall/6 water level gauging stations, one monitoring station, and dissemination/transmission system with cellular phone network, radio and siren



CDPP
Agricultural Development on Lahar Area
To develop lahar covered river area as agriculture land for livelihood development for the severely affected people

CDPP
Community Road Rehabilitation
Community road rehabilitation for the Bucao River basin (48 km) and the Sto. Tomas River basin (60 km) to trigger the various community development in the mountain remote area

Non-structural
Watershed Management
Forest management, foothill management and sediment control

CDPP
Community-based Forest Management (CBFM)
To develop 25,000 ha of forest including agro-forestry under CBFM program as livelihood development for the remote community in the mountain area

CDPP
Establishment of Aeta Assistance Station (AETAS)
To recover the Aeta community and to preserve their culture, history and the traditional life

CDPP *<Further monitoring of water quality and study are recommended prior to implementation>*

Community Development in Mapanuepe Lake Basin
To utilize water resources in Mapanuepe Lake for irrigation, inland fishery and tourism as income generation measures in the communities submerged by the dammed-up lake

Location Map of Master Plan

Structural
Bucao River
1) Heightening of existing right dike (l=7.5 km) and construction of new dike downstream from the bridge (l=2.1 km on left bank, l=2.4 km on right bank)
2) Reconstruction of Bucao Bridge (321 lm)
3) Observation of hydrological/geological data at Maraunot Notch
<to be included in the warning system>

Project Cost:	1,678 million pesos
EIRR:	15.7%
Environment:	No particular issues
Resettlement:	29 families (as of May 2003)
Schedule:	2007-2010 (construction)


Bucao Bridge (during Flood)

Non-structural
Warning System
7 Rainfall/6 water level gauging stations, one monitoring station, and dissemination/transmission system with cellular phone network, radio and siren
Evacuation System
Designation of 10 evacuation centers and dissemination of hazard map

Project Cost:	30 million pesos (operation for 10 years) 82 million pesos (GSM)
EIRR:	Not calculated
Environment:	No particular issues
Social Impact:	Positive impact to secure human life
Schedule:	2003-08 (pilot operation) 2007-12 (GSM system)

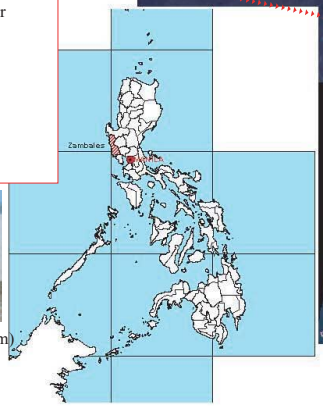
Structural
Sto. Tomas River
Heightening of existing dike (l=13.4 km), strengthening of existing dike (l=13.9 km) and construction of new dike (l=2.0 km) with Gabor River drainage improvement (l=1.7 km)

Project Cost:	1,960 million pesos
EIRR:	26.3%
Environment:	No particular issues
Resettlement:	77 families (as of May 2003)
Schedule:	2007-2010 (construction)


Sto. Tomas River (Middle reach, looking downstream)

CDPP
Agricultural Development on Lahar Area
Pilot project for agricultural development on lahar for 10 ha in the Bucao downstream and 10 ha for the Sto. Tomas middle reach.

Project Cost:	19 million pesos (pilot)
EIRR:	9.8%
Environment:	No particular issues
Social Impact:	Positive impact for poverty reduction
Schedule:	2008-2010 (20 ha)



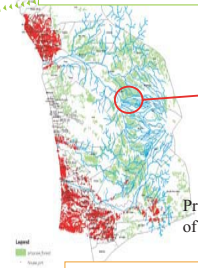
CDPP
Community Road Rehabilitation
Community road rehabilitation in Bucao River basin for route-A1 of 16 km

Project Cost:	189 million pesos (Route-A1)
EIRR:	2.1%
Environment:	Positive impact for forest management
Social Impact:	Positive impact for poverty reduction, and enhancement of social services
Schedule:	2005-2007


Baquilan Bridge

CDPP
Community-based Forest Management (CBFM)
Extension of CBFM with 2,200 ha as pilot development scheme

Project Cost:	76 million pesos (pilot)
EIRR:	21.5%
Environment:	Positive impact for forest conservation/management
Social Impact:	Positive impact for poverty reduction
Schedule:	2007-2012 (2,200 ha)




Priority Development Area of CBFM (green)

CDPP
Establishment of Aeta Assistance Station (AETAS)
Support to NGOs' activities for Aeta Upland Farming school, assistance for registration of ancestral domain land, livelihood development program and detailed study for establishment of Aeta Assistance Station.

Project Cost:	15 million pesos
EIRR:	Not calculated
Environment:	Positive impact for forest management
Social Impact:	Positive impact for prevention of tradition, culture of Aeta tribe
Schedule:	2005-2009 (pilot scheme)

Monitoring Station
- Rain
- Rain&WaterLevel
- WaterLevel
- Evacuation Center
- Bucao Bridge
- Community Road
- River Stractural Measure

Non Stractural Measure
- CBFMProject
- Lahar Agriculture
- AETAs
- Watershed boundary
- Municipality boundary
- Project Area

Aeta people

Location Map of Proposed Priority Projects

THE STUDY
ON SABO AND FLOOD CONTROL
FOR WESTERN RIVER BASINS OF MOUNT PINATUBO
IN THE REPUBLIC OF THE PHILIPPINES

Outline of the Study

1. River Basin Condition

1.1	Mount Pinatubo	Location	Central Luzon
		Peak	EL.1,449 m (EL.1,745 m before eruption)
		Crater lake	2.4 km^2 at EL.920 m (January 2003)
		Maraunot Notch	Andesite, fluvio-lacustrine deposit and dacite
1.2	Bucao River	Basin area	655 km^2 (646 km^2 before eruption)
		River length	36.0 km
		River gradient	1/270 at downstream (1/400 before eruption)
1.3	Maloma River	Basin area	152 km^2 (151 km^2 before eruption)
		River length	17.8 km
		River gradient	1/800 at downstream (1/1,200 before eruption)
1.4	Sto. Tomas River	Basin area	262 km^2 (262 km^2 before eruption)
		River length	32.8 km
		River gradient	1/300 at downstream (1/450 before eruption)
		Mapanuepe lake	6.8 km^2 in surface area, 30 million m^3 in capacity
1.5	Socio-economy	Population	228,148 for 8 municipalities (2000 census) (433,542 for Zambales, 8,030,945 for Region 3)
		Un-employment	37.9% for Zambales, 10.0% for Region 3 (2000)
		Family income	P123,667/year for Zambales (2000) (P144,039 for nation, P151,449 for Region 3)
1.6	Rainfall/Flood	Annual rainfall	3,600 mm in Iba (average)
		Probable flood peak	3,800 m^3/s in Bucao, 810 m^3/s in Maloma and 1,200 m^3/s in Sto. Tomas River for 20-year probable flood
1.7	Sediment	Sediment delivery	13 MCM (2003) & 2.9 MCM (2010) in Bucao, and, 7.1 MCM (2003) & 1.4 MCM (2010) in Sto. Tomas
		Channel deposit	843 MCM in Bucao and 818 MCM in Sto. Tomas (2002)
1.8	Flood damages	Inundation area	11.1 km^2 for Bucao, 5.5 km^2 for Maloma and 58.9 km^2 for Sto. Tomas River for 20-year probable flood
		Death records	215 persons died after eruption in Zambales.
1.9	Land use	Current land use	69% of forest area and 31% of alienable and disposable land in Zambales

2. Existing River and Other Structures

2.1	Bucao River	Dike	6 km long right dike, a 300 m long spur dike, riverbank protection
		Bucao Bridge	300 m long, built in 1939

		Others	Irrigation facilities, a drainage outlet
2.2	Maloma River	Dike	3.2 km long left dike, riverbank protection
		Maloma Bridge	90 m,
2.3	Sto. Tomas River	Dike	19.1 km long left dike, 7.6 km long right dike, riverbank protection
		Maculcol Bridge	381 m long,
		Dalanawan channel	170 m long and 8m wide to drain the Mapanuepe lake water
		Bayarong dam	Tailings dam for Dizon copper mines, 126 m high,
2.4	Evacuation system	Warning system	AFP/PNP watch points, disaster information and evacuee's own judgment,
		Evacuation center	36 evacuation centers
2.5	Resettlement center	Center by MPC	7 resettlement centers,
		Center by NGO	3 resettlement centers,

3. Basic Concept of Recovery and Development

3.1	JICA study	Study period	March 2002 to September 2003
		Study area	Western river basins of Mount Pinatubo including Bucao, Maloma and Sto.Tomas River basins
		Scope of the study	1) Formulation of sabo and flood control master plan and selection of priority projects 2) Feasibility study for priority projects 3) Transfer of technology
3.2	Needs	Recovery actions	1) Mitigation of flood/mudflow inundation and damages in lowland area 2) Securing of national highway against flood/ mudflow 3) Recovery of life/livelihood in mountainous area affected by volcanic materials/lahar
		Basin development	1) Agriculture and tourism development 2) Final target of sustainable economic growth with uplifting of living standard
3.3	Study concept	1) Target year of 2022 for master plan 2) Combination of implementation of structural/non-structural measures and establishment of community-based disaster prevention systems 3) Target of poverty alleviation	

4. Master Plan for Sabo and Flood Control

4.1	Structural measures	Bucao River	1) Heightening of existing right dike (l=6.7 km) and construction of new dike downstream from the bridge (l=1.9 km on left bank, l=2.4 km on right bank) 2) Reconstruction of Bucao Bridge (355 m long) 3) Observation of hydrological/geological data at Maraunot Notch

			4) Consolidation dam and sand pocket <Review>
		Maloma River <Review>	1) Channel improvement with straightening, widening and dike heightening/construction (l=7 km) 2) Reconstruction of Maloma Bridge (240 m long)
		Sto.Tomas River	1) Heightening of existing dike (l=13.6 km), strengthening of existing dike (l=13.6 km) and construction of new dike (l=2 km) with Gabor River drainage improvement 2) Reconstruction of Maculcol Bridge (430 m long) 3) Consolidation dam/sand pocket/channel works <Review>
4.2	Non-structural measures	Warning system	7 Rainfall/6 water level gauging stations, one monitoring station, and dissemination/ transmission system with cellular phone network, radio and siren
		Evacuation system	1) Increase of 60 evacuation centers 2) Renovation of 32 evacuation centers 3) Dissemination of hazard map
		Watershed management	Forest management, foothill management, and sediment control
4.3	Community-based disaster prevention systems	Improvement of Tektek RC	Integration of three NGOs' resettlement centers in Tektek RC and improvement of community infra. <Further discussion and study>
		CBFM	Extension of CBFM for creation of livelihood.
		Agricultural development	Agricultural development on lahar at the river side area for livelihood development.
		Basin development of Mapanuepe Lake	Community development of Mapanuepe Lake basin for irrigation, inland fishery and tourism <Further monitoring and study>
		Community road	Community road rehabilitation in Bucao and Sto.Tomas River basins
		AETAS	Establishment of Aeta Assistance Station

5. Priority Projects (Feasibility Projects)

5.1	Structural measures	Bucao River	1) Heightening of existing right dike (l=7.5 km) and construction of new dike downstream from the bridge (l=2.1 km on left bank, l=2.4 km on right bank) 2) Reconstruction of Bucao Bridge (321 m long) 3) Observation of hydrological/geological data at Maraunot Notch
		Sto.Tomas River	1) Heightening of existing dike (l=13.4 km), strengthening of existing dike (l=13.9 km) and

			construction of new dike (l=2.0 km) with Gabor River drainage improvement (l=1.7 km)
5.2	Non-structural measures	Warning system	7 Rainfall/6 water level gauging stations, one monitoring station, and dissemination/ transmission system with cellular phone network, radio and siren
		Evacuation system	Designation of ten evacuation centers, Dissemination of hazard map.
5.3	Community-based disaster prevention systems	CBFM	Extension of CBFM with 2,200 ha as pilot development scheme.
		Agricultural development	Pilot project for agricultural development on lahar for 10 ha at the Bucao downstream and 10 ha for the Sto.Tomas middle reach.
		Community road rehabilitation	Community road rehabilitation in Bucao River basin for route-A1 of 16 km.
		AETAS	Supporting NGOs' activities for Aeta Upland Farming school, assisting for registration of ancestral domain land, livelihood development program and the detailed study for establishment of Aeta Assistance Station,
5.4	Implementation	Organization	1) MPE-PMO, DPWH functioning as implementation agency for the structural measures, 2) PMO-Zambales under Zambales Province functioning as implementation agency for the non-structural and CDPP measures 3) Establishing Project Coordination Committee (PCC) to be functioning for integration among structural, non-structural and CDPP measures.
		Funding source	GOP and foreign assistance
5.5	Project Evaluation	Bucao River Structural Measures	1) Project Cost: 1,678 million pesos 2) EIRR: 15.7% 3) Environment: No particular issues 4) Resettlement: Plan formulated (29 families, as of May 2003) 5) Evaluation: To be implemented 6) Schedule: 2007-2010 (construction)
		Sto.Tomas River Structural Measures	1) Project Cost: 1,960 million pesos 2) EIRR: 26.3% 3) Environment: No particular issues 4) Resettlement: Plan formulated (77 families, as of May 2003) 5) Evaluation: To be implemented 6) Schedule: 2007-2010 (construction)
		Non-structural Measures	1) Project Cost: 30 million pesos (operation for 10 years)

		82 million pesos (GSM)
Warning and evacuation system	2) EIRR:	Not calculated
	3) Environment:	No particular issues
	4) Social Impact:	Positive impact to secure human life
	5) Evaluation:	To implement improving the existing system
	6) Schedule:	2003-08 (pilot operation) 2007-12 (GSM system)
CDPP-CBFM	1) Project Cost:	76 million pesos (Pilot)
	2) EIRR:	21.5%
	3) Environment:	Positive impact for forest conservation/management
	4) Social Impact:	Positive impact for poverty reduction
	5) Evaluation:	To implement (Pilot)
	6) Schedule:	2007-2012 (2,200 ha)
CDPP-Agricultural development on lahar area	1) Project Cost:	19 million pesos (Pilot)
	2) EIRR:	9.8%
	3) Environment:	No particular issues
	4) Social Impact:	Positive impact for poverty reduction
	5) Evaluation	To implement (pilot)
	6) Schedule:	2008-2010 (20 ha)
CDPP-Community road rehabilitation	1) Project Cost:	189 million pesos
	2) EIRR:	2.1%
	3) Environment:	Positive impact for forest management
	4) Social Impact:	Positive impact for poverty reduction and social services
	5) Evaluation:	To implement (Route-A1)
	6) Schedule:	2005-2007
CDPP-AETAS	1) Project Cost:	15 million pesos
	2) EIRR:	Not calculated
	3) Environment:	Positive impact for forest management
	4) Social Impact	Positive impact for preservation of tradition, culture of Aeta tribe
	5) Evaluation:	To assist NGOs' activities
	6) Schedule:	2005-2009 (pilot scheme)

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FINAL REPORT

VOLUME II

MAIN REPORT

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Abbreviations

A	AADT	-	Annual Average Daily Traffic
	AD		Administrative Order
	ADA	-	Aeta Development Association
	ADB	-	Asian Development Bank
	AETAS	-	Aeta Assistance Station
	AFM	-	Acoustic Flow Monitors
	AFP	-	Armed Forces of the Philippines
	ARMM	-	Autonomous Region of Muslim Mindanao
	ASTM	-	American Society for Testing and Materials
	ATI	-	Agricultural Training Institute
B	BAS	-	Bureau of Agricultural Statistics
	BDCC	-	Barangay Disaster Coordinating Council
	BOD	-	Biochemical Oxygen Demand
	BOD		Bureau of Design, DPWH
	BOT	-	Build-Operate-Transfer
	BRS	-	Bureau of Research and Standards, DPWH
	BSWM	-	Bureau of Soils and Water Management, DA
C	Ca	-	Calcium
	CAD	-	Computer Aided Design
	CAR	-	Cordillera Administrative Region
	CARP-IC	-	Comprehensive Agrarian Reform Program – Irrigation Component
	CBFM	-	Community-Based Forest Management
	CDC	-	Clark Development Corporation
	CDCC	-	City Disaster Coordinating Council
	CDPP	-	Community-Based Disaster Prevention Plan
	CENRO	-	Community Environment and Natural Resources Office
	CIP	-	Communal Irrigation Project
	CIS	-	Communal Irrigation System
	COD	-	Chemical Oxygen Demand
	COMVOL	-	Commission on Volcanology
	CPDO	-	City Planning and Development Office
	CPI	-	Consumer Price Index
D	DA	-	Department of Agriculture
	DAR	-	Department of Agrarian Reform
	DBM	-	Department of Budget and Management
	DCSMI	-	Dizon Copper & Silver Mines, Inc.
	DENR	-	Department of Environment and Natural Resources
	DEO	-	District Engineering Office
	DepEd	-	Department of Education
	DILG	-	Department of Interior and Local Government
	DIV	-	Dutch Intervention Value
	DND	-	Department of National Defense
	DO	-	Department Order

	DOE	-	Department of Energy
	DOH	-	Department of Health
	DOST	-	Department of Science and Technology
	DOTC	-	Department of Transportation and Communications
	DPWH	-	Department of Public Works and Highways
	DSWD	-	Department of Social Welfare and Development
	DTI	-	Department of Trade and Industry
	DTM	-	Digital Topographic Map
E	EC	-	Electric Conductivity
	ECC	-	Environmental Compliance Certificate
	EHS	-	Environmental Health Service
	EIA	-	Environmental Impact Assessment
	EIS	-	Environmental Impact Statement
	EIRR	-	Economic Internal Rate of Return
	EMB	-	Environmental Management Bureau, DENR
	EO	-	Executive Order
	EPZA	-	Export Processing Zone Authority
F	FMB	-	Forest Management Bureau, DENR
	FY	-	Fiscal Year
G	GIS	-	Geographic Information System
	GDP	-	Gross Domestic Product
	GOJ	-	Government of Japan
	GOP	-	Government of the Philippines
	GRDP	-	Gross Regional Domestic Product
	GSM	-	Global System for Mobile Communications
	GVA	-	Gross Value Added
H	HH	-	Household
	HUDCC		Housing and Urban Development Coordinating Council
I	ICC	-	Investment Coordination Committee, NEDA
	IEE	-	Initial Environmental Examination
	IR	-	Inflation Rate
	IRA	-	Internal Revenue Allotment
	IRR	-	Implementing Rules and Regulations
	IRRI	-	International Rice Research Institute
	IPs	-	Indigenous Peoples
	ISF	-	Irrigation Service Fee
J	JBIC	-	Japan Bank for International Cooperation
	JICA	-	Japan International Cooperation Agency
K	K	-	Potassium
	KPA	-	Key Production Area
L	LGU	-	Local Government Unit

	LLDA	-	Laguna Lake Development Authority
	LWUA	-	Local Water Utilities Administration
M	MDCC	-	Municipal Disaster Coordinating Council
	MFDP	-	Major Flood Control and Drainage Project
	MGB	-	Mines and Geosciences Bureau, DENR
	MOA	-	Memorandum of Agreement
	MOOE	-	Maintenance Organization and Operation
	MPC	-	Mount Pinatubo Commission
	MPE	-	Mount Pinatubo Emergency, DPWH
	MPR	-	Mount Pinatubo Rehabilitation, DPWH
	MTPDP	-	Medium-Term Philippine Development Plan
	MTPIP	-	Medium-Term Public Investment Plan
	MWSS	-	Metropolitan Waterworks and Sewerage System
N	N	-	Nitrogen
	Na	-	Sodium
	NAMRIA	-	National Mapping and Resource Information Authority
	NAPOCOR	-	National Power Corporation
	NCIP	-	National Commission on Indigenous People
	NCR	-	National Capital Region
	NDCC	-	National Disaster Coordinating Council
	NEDA	-	National Economic and Development Authority
	NGO	-	Non-Government Organization
	NHA	-	National Housing Authority
	NIA	-	National Irrigation Administration
	NIP	-	National Irrigation Project
	NIPAS	-	National Integrated Protected Areas System
	NIS	-	National Irrigation System
	NSCB	-	National Statistical Coordination Board
	NSO	-	National Statistics Office
	NWRB	-	National Water Resources Board
	NWRC	-	National Water Resources Council
O	OCD	-	Office of Civil Defense
	ODA	-	Official Development Assistance
	OJT	-	On the Job Training
	O&M	-	Operation and Maintenance
P	P	-	Phosphorus
	PAGASA	-	Philippine Atmospheric, Geophysical and Astronomical Services Administration
	PAMB	-	Protected Areas Management Board
	PCC	-	Project Coordination Committee
	PCM	-	Project Cycle Management
	PCSD	-	Philippine Council for Sustainable Development
	PDCC	-	Provincial Disaster Coordinating Council
	PDDP-IC	-	Pampanga Delta Development Project – Irrigation Component

	PHIVOLCS	-	Philippine Institute of Volcanology and Seismology
	PIDIC	-	Pampanga Irrigation Development-Irrigation Component
	PIO	-	Provincial Irrigation Office
	PMO	-	Project Management Office
	PNP	-	Philippine National Police
	PO	-	People's Organization
R	RA	-	Republic Act
	RAAMPE	-	Rehabilitation of Areas Affected by Mt. Pinatubo Eruption
	RAP	-	Recovery Action Plan
	RC	-	Resettlement Center
	RDC	-	Regional Development Council
	RDCC	-	Regional Disaster Coordinating Council
	RES	-	Regional Equipment Service
	ROW	-	Right of Way
	RWS	-	Rural Waterworks System
S	SALT	-	Slope Agriculture Land Technology
	SAPI	-	Special Assistance for Project Implementation
	SBMA	-	Subic Bay Metropolitan Authority
	SCF	-	Standard Conversion Factor
	SDR	-	Swiss Disaster Relief
	SO_4	-	Sulfate
	SWIM	-	Small Water Impounding Management
T	TAV	-	Total Assessed Value
	TLRC	-	Technology & Livelihood Research Center
	TWG	-	Technical Working Group
	TSP	-	Total Suspended Particulates
U	USACE	-	United States Army Corps of Engineers
	USAID	-	United States Agency for International Development
	USGS	-	United States Geological Survey
V	VAT	-	Value Added Tax
W	WCLDP	-	West Central Luzon Development Program
	WHO	-	World Health Organization
Z	ZAMECO	-	Zambales Electric Cooperative

Measurements

Length

mm	=	millimeter
cm	=	centimeter
m	=	meter
km	=	kilometer
LM	=	linear meter

Volume

cm^3	=	cubic centimeter
l	=	liter
kl	=	kiloliter
m^3	=	cubic meter
MCM	=	million cubic meter

Weight

g	=	gram
kg	=	kilogram
ton	=	metric ton
meq	=	milligram equivalent

Time

sec	=	second
min	=	minute
hr	=	hour
d	=	day
y	=	year

Area

m^2	=	square meter
ha	=	hectare
km^2	=	square kilometer

Derived Measures

m/s	=	meter per second
m^3/s	=	cubic meter per second
kWh	=	kilowatt hour
MWh	=	megawatt hour
GWh	=	gigawatt hour
ppm	=	parts per million
kmph	=	kilometer per hour
lps/m	=	liter per second per meter

Currency

PHP	=	Philippine Peso
¥	=	Japanese Yen
US$	=	US Dollar

Other Measure

%	=	percent
^{o}	=	degree
^oC	=	degree(s) Celsius
10^3	=	thousand
10^6	=	million
10^9	=	billion
pH	=	potential of hydrogen
mbgs	=	meter below ground surface
M	=	magnitude of earthquake