
THE STUDY ON COMPREHENSIVE DISASTER PREVENTION AROUND MAYON VOLCANO

OUTLINE OF THE STUDY

(Part I : Master Plan)

1. Objectives of the Study

The objectives of the Study are:

- 1) to formulate a master plan on comprehensive disaster prevention measures around Mayon Volcano in the Republic of the Philippines,
- 2) to conduct a feasibility study for prioritized projects selected by the master plan, and
- 3) to transfer technical knowledge to the counterpart personnel to be dispatched by GOP in the course of the Study.

2. Disasters Focused in the Study and Basic Concept on Disaster Prevention

The disasters to be brought by hazards of “volcanic eruption”, “flood & debris flow” and “typhoon” are focussed in the Study in compliance with the terms of reference given by JICA. Disaster stems from the fact that certain communities or structures are vulnerable to these hazards. Thus, disaster may be logically given by the following equation: Hazard x Vulnerability = Disaster.

Countermeasures considered in this Study are classified into two categories in terms of hazard – vulnerability relationship as follows:

- Mitigation measures for hazard magnitude: Sabo Facilities, River Improvement and Urban Drainage
- Reduction of vulnerabilities: Forecasting and Warning System, Evacuation System, and Relocation and Resettlement

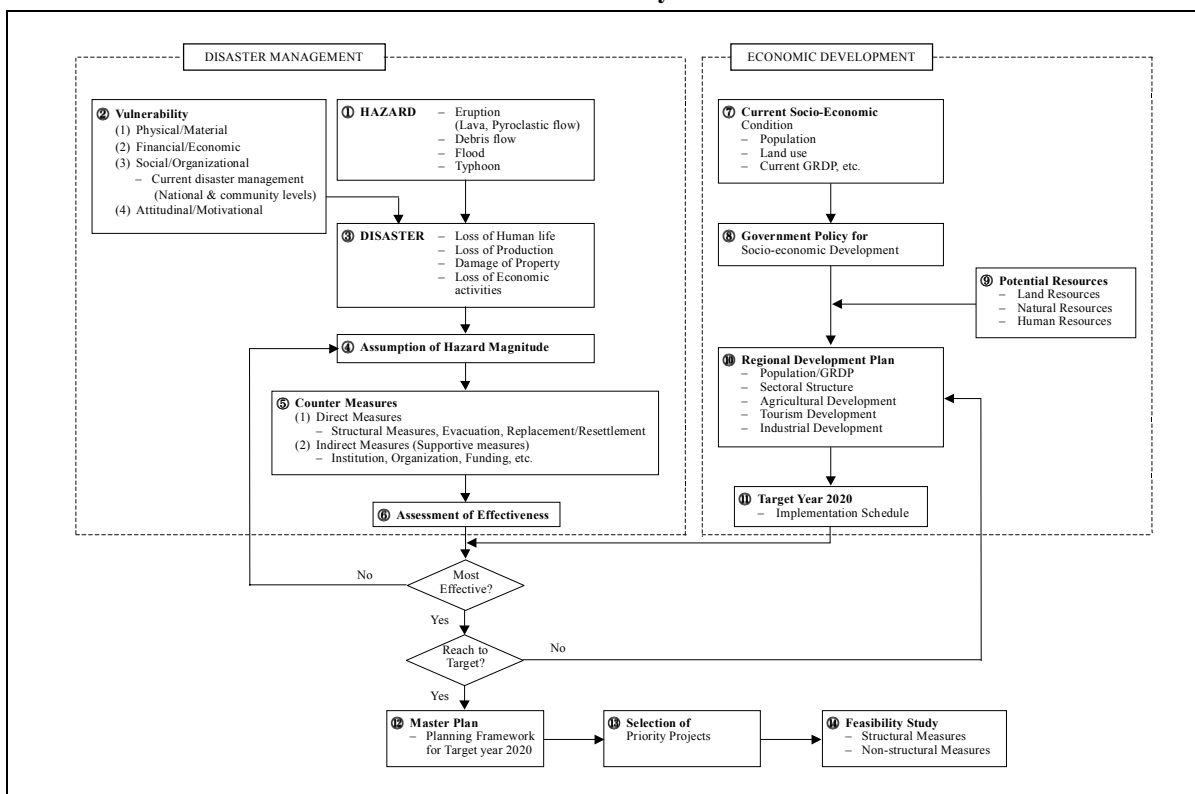
3. Disasters in the Study Area and Economic Development

The Study Area around Mayon Volcano in Albay Province is subjected to volcanic hazards, floods and debris flows usually caused by typhoons, seasonal heavy rains, and other disasters. Albay Province, one of the six provinces in Bicol Region, occupies 14.5% of the region’s total land area, while its population accounts for

23.2% of the regional total. To the contrary, the average calamity fund released in two years of 1996-97 was PHP71.4 million, which accounts for 36.1% of the Bicol Region and 10.7% of the national total. This relatively large share indicates that the province is subjected to various natural disasters and their damages.

JICA Study Team’s view on the interrelation of disaster management and economic development, and study flow is shown in the following figure.

Interrelation between Disaster Prevention and Economic Development and Study Flow



4. Socioeconomic Framework

(1) GRDP target

As agreed the Steering Committee Meeting held on March 12, 1999, the Study Team assumed that the level of per capita GRDP of the Study Area in the growth scenario by excluding NCR, which corresponds to the low growth one of three scenarios as low, medium and high, would reach to the national level of US\$3,222 as a target by the year 2020. According to this scenario, GRDP of the Study Area must increase at 10.22% per annum and per capita GRDP will grow at the rate of 8.43% per annum.

The growth rate in the past is extremely low comparing with the target.

According to the estimates by the Study Team, the growth rates of GRDP and per capita GRDP of Albay Province during the period from 1995 to 1998 are 4.38% per annum and 1.96% per annum respectively. The ones of the Study Area are assumed to be the same trend. The study is made to examine how to achieve the target in accordance with the scenario as set forth in Section 3.2 (2) “Interrelation between Disaster Prevention and Economic Development.”

(2) Scenario to realize the target

Case without Disaster Prevention Measures

By taking account of extremely low level of contribution to economic growth by disaster prevention works as mentioned above, the contribution ratio to economic growth of disaster prevention is extracted from the annual average growth rate of actual GRDP of Albay Province and City/Municipality in the Study Area in the past.

Case with Disaster Prevention Measures

As the result of study on the relations among GRDP, investment cost for disaster prevention and disaster damage amounts in Albay Province. On the basis of these conditions mentioned above, the degree/possibility of achievement of the targeted GRDP in case of with disaster prevention measures was studied as follows.

The assumption for average annual growth rate by sector during the period from 1998 – 2005

The natural growth rate and the development growth rate of Albay Province and the Study Area are set up by sector. The development growth rate of Agricultural Sector is set up on the basis of growth agricultural productivity assumed in the medium-term economic development projects of Albay Province and Legazpi City/Municipalities during the period from 1999 to 2004.

The development growth rate of Industry/Service Sector is set up by calculating the amount of production induced to sectors of industry and service which will be generated from GRDP of agricultural sector and the investment costs for construction sector in medium-term economic development projects in 2005. The induced amounts of production were estimated by taking account of the input coefficients and multiplier coefficients by sector in the Input-Output Table provided by NSCB.

The growth rate of economic development plans of industrial sector proposed in the Study is estimated in order to confirm the

degree/possibility of achievement of the targeted GRDP in the Study Area.

The assumption for average annual growth rate by the sector during the period from 2005 to 2020

Since the long-term economic development plan from 2005 to 2020 have no definite budgets, the growth rate of GRDP by sector is estimated under the following assumptions.

- Agricultural Sector: The agricultural productivity is assumed to achieve the potential productivity of three times to the present productivity.
- Industry/Service Sector: The natural growth rate is assumed to be the same rate with the one during the period from 1998 to 2005. The development growth rate is set up by assuming the share by sector on basis of growth rate during the period from 1998 to 2005.

The detail of concepts and assumptions utilized for setting GRDP growth rate is shown in Section 4.1 of the Main Report.

**Per capita GRDP to be Achievable without Disaster Prevention Measures
(2005)**

(Unit: Pesos and US\$)

Disaster Prevention Measures	Target (A)		To be achieved (B)		(B)/(A) (%)
	Peso	US\$	Peso	US\$	
Without			25,941	673	75.1
With			34,377	892	99.5
Case with Industrial Development Plan and the Projects in the Study	34,565	897	31,896	827	92.3

Note: Exchange rate of peso to US\$ is set up at 38.55 peso as of May 31, 1999.

**Per capita GRDP to be Achievable without Disaster Prevention Measures
(2020)**

(Unit: Pesos and US\$)

Disaster Prevention Measures	Target (A)		To be achieved (B)		(B)/(A) (%)
	Peso	US\$	Peso	US\$	
Without	124,217	3,222	38,902	1,009	31.3
With	31,514	817	133,250	3,457	107.3

Note: Exchange rate of peso to US\$ is set up at 38.55 peso as of May 31, 1999.

In case of “with Disaster Prevention Measures”, per capita GRDP is supposed to reach the target US\$3,457 in 2020 and the target US\$892 in 2005. The achievement ratio to the target GRDP in case of Industrial Development Plan and the projects proposed in the Study is 92.3%. Target

GRDP will be achieved if these investment for the infrastructure and the industrial production cost are included in calculation. The achievement ratio to the target in case of “without Disaster Prevention Measures” is extremely lower than the one of “with Disaster Prevention Measures”

The comprehensive disaster prevention works will trigger to promote the economic development plans proposed by this Study and the local government units (LGU), to accelerate the economic growth by synergy effects and to increase the per capita GRDP. As a result of it, the financial surplus of each LGU will be generated from increase of financial revenue. The affordability to burden the operation and maintenance cost for the projects was tentatively calculated for Legazpi City and Daraga Municipality .

Judging from discussion above, Legazpi City would be able to burden enough the operating and maintenance cost by its flood control budget in the target year of 2020. It appears that the development budget as a source of flood control budget of Daraga Municipality exceeds the operating and maintenance cost by revising the allotment rate of the development budget to flood control budget or by the subsidies by the national Government and/or loan from financial institution.

5. Basic Concepts and Strategies for Master Planning

In view of the issues identified in past disaster prevention activities and based on the results of discussions in the Steering Committee meetings, the following were adopted as basic strategies for formulating a Comprehensive Disaster Prevention Plan around Mayon Volcano in the target year of 2020.

- | |
|--|
| <ul style="list-style-type: none"> ① No deaths due to at any natural hazards like Mayon eruption, mud and debris flow, typhoon and flood, ② No damages to properties for the hazards of a 20-year probable mud and debris flow and 10-year probable flood, and ③ GRDP in the Study Area to reach to the national average level in 2020. |
|--|

To formulate a long-term sustainable disaster prevention plan in the Study Area, the following three broad coping measures or “direct countermeasures” were conceived:

- Countermeasure I : Prevention and mitigation
- Countermeasure II : Evacuation
- Countermeasure III : Relocation and/or resettlement)

In formulating the Master Plan projects and programs, a combination of three coping strategies or countermeasures were proposed in each area, river system or river.

6 Master Plan Projects and Programs

There are wide ranges of requirements for strengthening of the disaster prevention or establishment of a comprehensive disaster prevention system around Mayon Volcano. Among others, the following 16 projects and programs were identified through the Master Plan Study.

- (1) Sabo Facility Construction
 - 1) (SF-1) Yawa River System Sabo Project
 - 2) (SF-2) Quinali (A) System Sabo Project
 - 3) (SF-3) Buang River Sabo Project
 - 4) (SF-4) San Vicente Sabo Project
 - 5) (SF-5) Padang River Sabo Project
 - 6) (SF-6) Basud river Sabo Project
 - 7) (SF-7) Bulawan River Sabo Project
- (2) River Improvement
 - 8) (RI-1) Yawa River Improvement Project
- (3) Urban Drainage
 - 9) (UD-1) Legazpi City Urban Drainage Project
- (4) Forecasting, Warning and Evacuation
 - 10) (FW-1) Forecasting, Warning and Evacuation System Strengthening Project
- (5) Relocation and Resettlement
 - 11) (RR-1) Relocation and Resettlement Project
- (6) Institutional and Supporting Services Strengthening Projects and Programs
 - 12) (NP-1) National and Regional Disaster Management System Strengthening
 - 13) (PP-1) Provincial Disaster Management system Strengthening

- 14) (PP-2) Province-wide Socioeconomic Development and Monitoring
- 15) (CP-1) Community-based Disaster Management Strengthening
- 16) (CP-2) Livelihood Development Projects and Programs

7. Summary of Estimated Project Cost

Total project cost for structural countermeasures is summarized below.

Project Cost for Structural Countermeasure Projects

(Unit: Million PHP)

Code No.	Description	Amount
Sabo Facility Construction		
SF-1	Yawa River System Sabo Project	2,344.5
SF-2	Quinali (A) River System Sabo Project	1,912.8
SF-3	Buang River System Sabo Project	249.1
SF-4	San Vicente River System Sabo Project	1,459.4
SF-5	Padang River System Sabo Project	960.4
SF-6	Basud River System Sabo Project	584.9
SF-7	Bulawan River System Sabo Project	769.2
River Improvement		
RI-1	Yawa River Improvement Project	509.2
Urban Drainage		
UD-1	Legazpi City Urban Drainage Project	643.7
Forecasting, Warning and Evacuation		
FW-1	Forecasting, Warning and Evacuation System Strengthening Project	3,740.2
Relocation/Resettlement		
RR-1	Relocation and Resettlement Projects	186.6
Total		13,360.0

Total project cost for institutional and supporting services strengthening programs is summarized below.

Project Cost for Institutional and Supporting Services Strengthening Programs

(Unit: Million PHP)

Code No.	Description	Amount
NP-1	National and Regional Disaster Management System Strengthening	53.9
PP-1	Provincial Disaster Management System Strengthening	2.2
PP-2	Province-wide Socio-economic Development and Monitoring	5.6
CP-1	Community-based Disaster Management Strengthening	11.3
CP-2	Livelihood Development and Supporting Projects and Programs	54.6
Total		127.6

As a conclusion of the project cost estimate, the total amount of investments necessary to attain the development objectives of this Master Plan is estimated at PHP 13,487.6 million.

8. Project Evaluation

The results of economic evaluation for preliminary selection are summarized below:

Results of Economic Evaluations for Preliminary Selection of the Projects

River system	Option No.	Return Period (Year)	EIRR (%)	B/C	NPV (15%) (Million. PHP)
1. Sabo Projects					
Yawa River	3	20	24.67	1.58	3,248.3
Quinali(A) River	3	20	16.32	1.07	88.3
Buang River	3	20	21.67	1.43	40.8
San Vicente River	3	20	18.49	1.21	103.1
Padang River	3	20	19.14	1.28	168.7
Basud River	3	20	14.00	0.95	-21.8
Bulawan River	3	20	17.16	1.16	700.4
2. Flood Control Project					
Yawa River	-	20	10.08	0.65	-65.9
3. Legazpi City Urban Drainage Project					
	-	10	23.96	1.73	197.4
4. Integrated Evaluation (as a Package)					
	-	-	22.40	1.43	2,938.3

9. Organization for Implementation of the Proposed Projects and Programs

The DPWH at the central and regional level is the executing agency responsible for implementation of the physical projects relating to the Sabo and flood control

works and their operations and maintenance. For overall supervision of the projects implementation, it is recommended to establish a “Project Management Office (PMO)” under the control of DPWH Region-V.

This PMO to be established in DPWH Region-V will be responsible for coordination of all matters relating to the overall implementation of the Master Plan projects and programs.

10. Implementation Schedule

The planning period up to the target year 2020 is divided into three phases: Phase I up to 2005, Phase II for 2006 – 2010, and Phase III for 2011 – 2020. The Master Plan projects and programs will be executed in these three phases as per the prioritized order, and following the implementation schedule (or staged procedures) as indicated in the following figure.

Implementation Schedule of the Master Plan Projects and Programs

Code No.	Description	Phase I (1999 - 2005)					Phase II (2006 - 2010)					Phase III (2011 - 2020)												
		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
		<i>Sabo Facility Construction</i>																						
SF-1	Yawa River System Sabo Project	[Gantt bar showing activity from 2000 to 2020]																						
SF-2	Quinali (A) River System Sabo Project	[Gantt bar showing activity from 2004 to 2020]																						
SF-3	Buang River Sabo Project	[Gantt bar showing activity from 2008 to 2020]																						
SF-4	San Vicente River Sabo Project	[Gantt bar showing activity from 2007 to 2020]																						
SF-5	Padang River Sabo Project	[Gantt bar showing activity from 2002 to 2020]																						
SF-6	Basud River Sabo Project	[Gantt bar showing activity from 2002 to 2020]																						
SF-7	Bulawan River Sabo Project	[Gantt bar showing activity from 2006 to 2020]																						
<i>River Improvement</i>																								
RI-1	Yawa River Improvement	[Gantt bar showing activity from 2002 to 2020]																						
<i>Urban Drainage</i>																								
UD-1	Legazpi City Urban Drainage Project	[Gantt bar showing activity from 2000 to 2020]																						
<i>Forecasting, Warning and Evacuation</i>																								
FW-1(1)	Forecasting, Warning and Evacuation System Strengthening	[Gantt bar showing activity from 2000 to 2020]																						
FW-1(2)	Strengthening & Development of Remnant Rainfall Gauging Stations and Evacuation Centers	[Gantt bar showing activity from 2011 to 2020]																						
<i>Relocation/ Resettlement</i>																								
RR-1	Relocation and Resettlement Projects	[Gantt bar showing activity from 2000 to 2020]																						
<i>Institutional and Supporting Services Strengthening</i>																								
NP-1	National and Regional Disaster Management System Strengthening	[Gantt bar showing activity from 2000 to 2020]																						
PP-1	Provincial Disaster Management System Strengthening	[Gantt bar showing activity from 2000 to 2020]																						
PP-2	Province-wide Socioeconomic Development and Monitoring	[Gantt bar showing activity from 2000 to 2020]																						
CP-1	Community-based Disaster Management Strengthening	[Gantt bar showing activity from 2000 to 2020]																						
CP-2	Livelihood Development Projects and Programs	[Gantt bar showing activity from 2000 to 2020]																						

Notes : [White box] Feasibility Study or Preparatory Study
 [Hatched box] Construction Works and/or Installation of Equipment
 [Dotted box] Detailed Design or Preparation of Works
 [Dark shaded box] Project Activity or O&M including Monitoring and Review

(Part II : Feasibility Study)

11. Priority Projects Selected in the Master Plan

In screening out the priority package projects and programs for feasibility study, an evaluation criteria composed of the following four key indicators was established and used:

- 1) Urgency of Implementation
Urgency might be assessed by the degree of imminence of the impending disaster.
- 2) Economic Advantage
The economic advantage can be represented by EIRR of the project.
- 3) Number of Beneficiaries and Affected People
- 4) Degree of Representation as a Model Project

12. Priority Core Projects and Supporting Projects/Programs

The following are the five priority core projects on which the feasibility study was conducted:

- 1) (SF-1) Yawa River System Sabo Project
- 2) (UD-1) Legazpi City Urban Drainage Project
- 3) (FW-1) Forecasting and Warning System Strengthening Project
- 4) (EV-1) Evacuation System Strengthening Project¹
- 5) (RS-1) Resettlement Sites Development Project² (Banquerohan in Legazpi City & Anislag in Daraga Municipality)
- 6) Supporting Projects and Programs

The supporting projects and programs are proposed to enhance and sustain the disaster prevention capacity. Among the supporting projects and programs proposed in the Master Plan, the following were selected based on the evaluation criteria stipulated in Section 11 and in consideration of the respective linkages with the core priority projects.

¹ FW-1 in Master Plan was divided into two: (FW-1) Forecasting & Warning and (WE-1) Evacuation in the light of evacuation's importance and effectiveness in reduction of casualties.

² Among (RR-1) Relocation and Resettlement Projects in Master Plan, the development of two resettlement sites were prioritized in relation to the core priority projects implementation.

- 1) (PP-1) Provincial Disaster Management System Strengthening
- 2) (PP-2) Province-wide Socio-economic Development and Monitoring
 - Aggregate Production Plant Project
 - Mineral Water Production Project
 - Productivity Enhancement Programs in the Protected Area
- 3) (CP-1) Community-based Disaster Management Strengthening
- 4) (CP-2) Livelihood Development Projects and Programs
 - Organization and Strengthening of Multi-purpose Cooperatives with Micro-lending Component
 - Agro-industry Development Project
 - Hollow Blocks Production

13. Summary of Estimated Project Cost

Total project cost for the priority projects is summarized below.

Summary of Project Cost

(Unit: million PHP)

Description	Foreign Currency	Local Currency	Total
1. Yawa River System Sabo Project	377.8	991.9	1,369.7
2. Legazpi City Urban Drainage Project	330.0	263.9	593.9
3. Forecasting and Warning System Strengthening Project	322.6	84.8	407.4
4. Evacuation System Strengthening Project	41.1	465.3	506.4
5. Resettlement Site Development Project	50.2	329.7	379.9
Subtotal (1. – 5.)	1,121.7	2,135.6	3,257.2
6. Supporting Programs	295.1	82.0	377.1
Total	1,416.8	2,217.6	3,634.4

14. Implementing Organization

The DPWH is the executing agency responsible for implementation of the physical projects and their operations and maintenance. For overall supervision of the projects implementation, a Project Management Office (PMO) will be established under the control of DPWH Region-V. The implementing agencies for the respective priority projects are as follows.

(1) Core Projects

Project Name	Implementation Agency
1. Yawa River System Sabo Project (SF-1)	DPWH
2. Legazpi City Urban Drainage Project (UD-1)	DPWH
3. Forecasting and Warning System Strengthening Project (FW-1)	
- Monitoring system of volcanic activities	PHIVOLCS
- Monitoring system of flood and mud flow	DPWH
- Warning system	BDCC
- Inter-agency disaster mitigation network	OCD
4. Evacuation System Strengthening Project (WE-1)	
- Evacuation center	DPWH
- Emergency shelter	LGUs
- Livestock sanctuary	LGUs
5. Resettlement Site Development Project (RS-1)	
- Banquerohan	Legazpi
- Anislag	Daraga

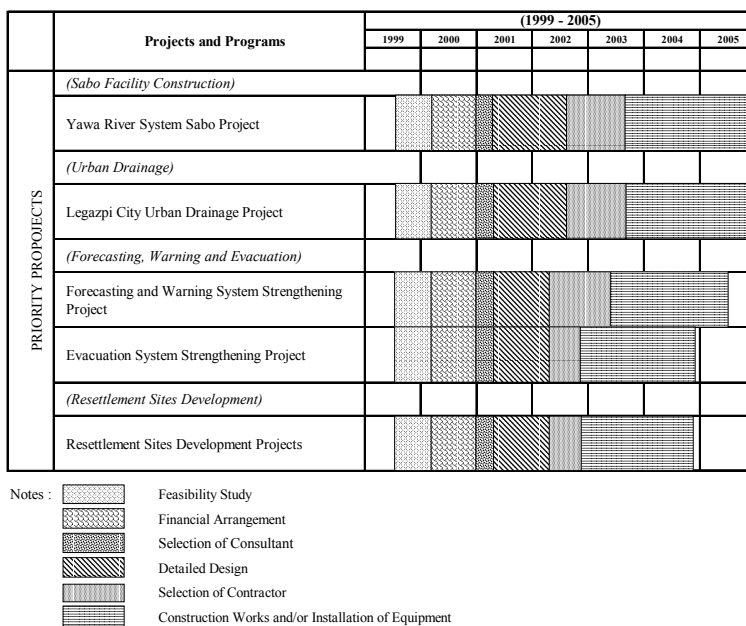
(2) Supporting Projects/ Programs

Program/ Project Name	Implementation Agency
1. Provincial Disaster Management System Strengthening (PP-1)	PDMO/ PDCC, OCD
2. Province-wide Socio-economic Development and Monitoring (PP-2)	LGUs concerned, Private sector
- Aggregate Production Plant Project	
- Mineral Water Development Project	
- Protected Area Development Project	
3. Community-based Disaster Management Strengthening (CP-1)	LDCC/ MDCCs
4. Livelihood Development Projects and Programs (CP-2)	LGUs concerned, Resettlers, Private sector, NGOs
- Organization and Strengthening of Multi-purpose Cooperatives with Micro Credit	
- Hollow Blocks Production	
- Agro-industry Development (abaca, philinuts and coco coir)	

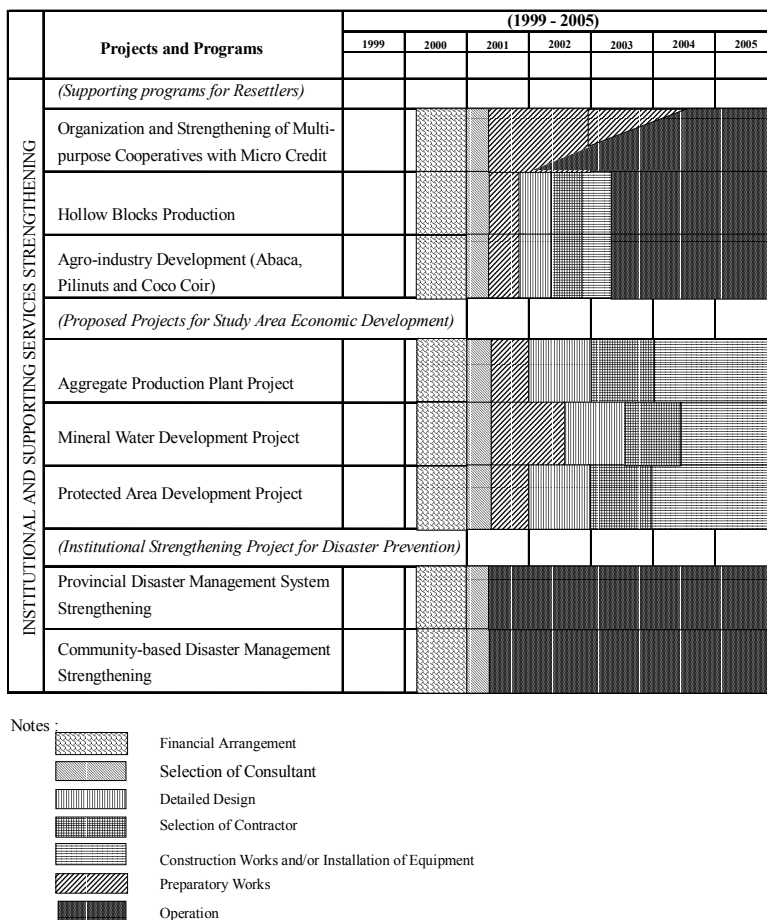
15. Implementation Schedule

Implementation schedules of the priority projects and institutional and supporting services strengthening projects and programs are shown in the following figures, respectively.

(1) Implementation Schedule of the Priority Projects



(2) Implementation of the Institutional and Supporting Services Strengthening Projects and Programs



16. Project Cost Sharing by Implementing Agency and O&M

The project cost sharing by implementing agency is summarized as shown below.

(Unit: million PHP)

Project	DPWH	PHIVOLCS	OCD	Legazpi City	Daraga	*LGUs	Total
1. Yawa River System Sabo	1,293.3			55.0	21.4		1,369.7
2. Legazpi City Urban Drainage	565.1			28.8			593.9
3. Forecasting and Warning System	193.2	64.6	149.5				407.4
4. Evacuation System Strengthening	460.4			4.1	1.2	40.7	506.4
5. Resettlement Site Development				222.4	157.5		379.9
Total	2,512.0	64.6	149.5	310.3	180.1	40.7	3,257.3

Note: *LGUs refer to Municipalities of Camalig, Guinobatan, Ligao, Malilipot, Sto. Domingo and Tabaco.

It is necessary to have an O&M plan before commencing construction/installation of equipment in order to achieve sustainable disaster prevention capacity. Thus, the implementing organization for each project is required to provide an operations and maintenance plan before any disbursement begins. An annual review of O&M activities and needs will be carried out by PMO.

17. Recommendations

To implement the proposed priority projects, it is highly recommended that the Philippine Government undertake them in consideration of the following suggestions.

- (1) Earlier Implementation of the Priority Projects and their Preparations.
 - 1) Preparations for Implementation of the Projects and Programs
 - a. Formation of a consensus through discussions in the related communities
 - b. Enlightenment of the people and participation of the communities
 - c. Promotion of the people's self-preparedness
 - 2) Appropriation of the Budget
 - a. Cost sharing between central government and local government units
 - b. Financial assistance from international institution or foreign country
 - 3) Establishment of the Implementation Structure
 - a. Institutional arrangements
 - b. Creation of the implementation organization
 - c. Involvement of the consultants including external intellectuals

- (2) Immediate Execution of the Practicable Matters with the Available Resources
 - 1) Collection and Preparation of the Basic Data
 - a. Socioeconomic statistics (population census, socio-economic indicators, land use, etc.)
 - b. Hydrological and river flow observations (rainfalls, stream and water level gauging, river bed changes, excavation volume of the sediment)
 - c. Disaster records (real situations in times of disaster occurrences, extent, intensity & impacts of the disaster, calamity fund)
 - d. Records on relocation and resettlement (no. of resettlers, inventory of resettlement site facilities and records on their rehabilitation, etc.)
 - e. Records on training and drills (practiced evacuation drills, educational programs for the people, educational campaigns, etc.)
 - f. Establishment of database
 - 2) Strengthening of the Disaster Prevention Activities by the People, NGOs, and Volunteers
 - a. Surveying and assessment of the dangerous areas and information networking
 - b. Awareness raising of the people and educational campaign for the school pupils
 - c. Preparedness for typhoon (clearing of drainage canals, cut-off of tree branches, etc.)
 - d. Reforestation
 - e. Practice of the disaster prevention drills
 - f. Publication of the information bulletins and accomplishment reports
 - g. Others
 - 3) Inspection of the Disaster Prevention Facilities and Establishment of Emergency Response System
 - a. Periodical inspections of the disaster prevention facilities and recordings (forecasting and warning, evacuation routes, evacuation centers, etc.)
 - b. Rehabilitation of the disaster prevention facilities and recording of the emergency responses

- 4) Preparation of Manuals for Disaster Coping
 - a. Monitoring, forecasting and warning
 - b. Evacuation
 - c. Rescue and remedy
 - d. Emergency rehabilitation
 - e. Maintenance of facility

- 5) Reliable Transmission of the Forecasting and Warning Information
 - a. Clarification of the duties and responsibilities
 - PAGASA : Forecasts on weather, typhoon and flood in a broad area
 - PHIVOLCS: Eruptions of Mayon Volcano
 - DPWH: Mud & debris flows and flood in a local area
 - b. Accurate data collection and forecasts
 - c. Timely transmission of the information
 - d. Periodical inspections and O&M of the facilities

- 6) Grasp of the Land Use Situation
 - a. Survey for grasping the current and future (sustainable) land use
 - b. Update of the land tax inventory
 - c. Preparation of the land use maps and their updating
 - d. Preparation of the future land use plan
 - e. Establishment of the common ownership system for the collected data and records

18. Eruptions of Mayon Volcano in February - March 2000

At the final stage of the Study, Mayon Volcano erupted in a series of explosions from the end of February to the beginning of March 2000. Although the stay period of the JICA Study Team was limited to few weeks for the 3rd Field Work, the Team conducted the site inspection of the latest eruptions, and also collected the relevant data from the PHIVOLCS.

Judging from the present state of things, the findings and views of the JICA Study Team are as follows:

- 1) The PHIVOLCS launched an investigation of the latest eruptions and prepared the preliminary report. Presently, the more detailed investigations are being carried out by the PHIVOLCS.

- 2) According to this preliminary report, the total ejecta volume is estimated at about 40 million m³ and this volume is less than 70 million m³ assumed in formulating the plan. From this respect, it is judged that there is no need to review the Master Plan as a whole.
- 3) In the Yawa river system where a Sabo project was subjected to the feasibility study, it is however likely that the pyroclastic flows have filled up the Bonga gully and the lava flowed over their deposits. According to the PHIVOLCS observations, the pyroclastic deposits may not cause immediately a large-scale collapsing hazard, since they were covered with lava flows.
- 4) Though less imminent in danger of their collapse for the time being, the Study Team strongly recommends the GOP to monitor the geomorphological state and movement of the Volcano summit portions especially in the Bonga gully, with a view to avoiding the unforeseen disaster.
- 5) If the conclusion of the final report to be prepared by PHIVOLCS requires, it might be necessary for the GOP to decide on the conduct of further detailed investigations.

In the Steering Committee meeting held on the 2nd June 2000, the views mentioned above were confirmed in the presence of the PHIVOLCS representative.

THE STUDY
ON
COMPREHENSIVE DISASTER PREVENTION
AROUND MAYON VOLCANO
IN
THE REPUBLIC OF THE PHILIPPINES

EXECUTIVE SUMMARY

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List of Acronyms

A&D	Alienable and Disposable Land
ADB	Asian Development Bank
AFP	Armed Forces of the Philippines
Agromet	Agro-meteorological Station, PAGASA
AIT	Asian Institute of Technology
ALECO	Albay Electric Cooperative
ALERT	Albay Legazpi Emergency Rescue Team
APDMC	Asia Pacific Disaster Management Centre
ARCs	Agrarian Reform Committees
ASEAN	Association of Southeast Asian Nations
BAS	Bureau of Agricultural Statistics
BCCARD	Bicol Consortium for Agricultural Resources and Research and Development
BDCC	Barangay Disaster Coordinating Council
BFP	Bureau of Fire Protection
BMG	Bureau of Mines and Geo-science
BOI	Board of Investment
BOT	Bureau of Telecommunication
BRAIC	Bicol Regional Agri-Industrial Center
BRBFCIDP	Bicol River basin Flood Control and Irrigation Development Project
BRS	Bureau of Research and Standard, DPWH
BSBI	Bicol Small Business Institute
BSWM	Bureau of Soils and Water Management
BU	Bicol University
BUCA	Bicol University College of Agriculture
BWAD	Bacacay Water District
CARP	Comprehensive Agrarian Reform Program
CASF	Composite Air Support Force
CBIS	Community-Based Information System
CDA	Cooperative Development Authority
CDCC	City Disaster Coordinating Council
CLUP	Comprehensive Land Use Plan
CNDR	Corporate Network for Disaster Response
CSG	Cemented Sand and Gravel
DA	Department of Agriculture
DA-BFAR	Department of Agriculture – Bureau of Fisheries and Aquatic Resources
DAR	Department of Agrarian Reform
DBM	Department of Budget and Management
DCC	Disaster Coordinating Council
DECS	Department of Education, Culture and Sports
DENR	Department Environment and Natural Resources
DFA	Department of Foreign Affairs
DILG	Department of the Interior and Local Government
DOE	Department of Energy
DOH	Department of Health
DOLE	Department of Labor and Employment
DOST	Department of Science and Technology
DOT	Department of Tourism
DOTC	Department of Transportation and Communication

DPWH	Department of Public Works and Highways
DSWD	Department of Social Welfare and Development
DTI	Department of Trade and Industry
EIA	Environmental Impact Assessment
EMB	Environmental Management Bureau
FIDA	Fiber Industry Development Authority, DA
GA	Government Agency
GDP	Gross Domestic Product
GOJ	Government of Japan
GOP	Government of the Philippines
GRDP	Gross Regional Domestic Product
GVA	Gross Value Added
HLURB	Housing and Land Use Regulatory Board
HUDCC	Housing and Urban Development Coordinating Council
IANDR	Inter-Agency Network for Disaster Response
IBRD	International Bank for Reconstruction and Development
IEE	Initial Environmental Examination
IRA	Internal Revenue Allotment
JBIC	Japan Bank for International Cooperation (Ex-OECF & EXIM)
JICA	Japan International Cooperation Agency
LARC	Local Amateur Radio Club
LBP	Land Bank of the Philippines
LGUs	Local Government Units
LINDGC	Legaspi – Iriga – Naga – Daet Growth Corridor
LTO	Land Transportation Office
LWD	Local Water District
LWUA	Local Water Utility Agency
M/D	Minutes of Discussion
MDCC	Municipal Disaster Coordinating Council
MLUC	Municipal Land Use Committee
MM	Minutes of Meeting
MMSL	Meters above Mean Sea Level
NAAD	Network of Areas for Agricultural Development
NAMRIA	National Mapping and Resource Information Authority
NAPHIRE	National Post Harvest Institute for Research and Extension
NCDPP	National Calamities and Disaster Preparedness Plan
NDCC	National Disaster Coordinating Council
NEDA	National Economic and Development Authority
NFA	National Food Authority
NGAs	National Government Agencies
NGOs	Non-Government Organizations
NHA	National Housing Authority
NIA	National Irrigation Administration
NIPAS	National Integrated Protected Areas System
NPC	National Power Corporation (or NAPOCOR)
NPAAD	Network of Protected Areas for Agricultural Development
NSCB	National Statistical Coordination Board
NSO	National Statistics Office
NTC	National Telecommunication Commission
OCD	Office of Civil Defense
O&M or O/M	Operation and Maintenance

PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PAMB	Protected Area Management Board
PCA	Philippine Coconut Authority
PCM	Project Cycle Management
PCBTSDP	Presidential Commission on Bicol Tourism Special Development Project
PCG	Philippine Coast Guard
PD	Presidential Decree
PDCC	Provincial Disaster Coordinating Council
PDMO	Provincial Disaster Management Office
PDZ	Permanent Danger Zone
PFDA	Philippine Fishery Development Authority
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PHO	Provincial Health Office
PIA	Philippine Information Agency
PNRC	Philippine National Red Cross
PMO	Project Management Office
PMS	Presidential Management Staff
PNP	Philippine National Police
PNR	Philippine National Railways
PPA	Philippine Port Authority
PPDO	Provincial Planning and Development Office
PPFP	Provincial Physical Framework Plan
PRA	Participatory Rural Appraisal
PSWDO	Provincial Social Welfare and Development Office
PTA	Philippine Tourism Authority
RA	Republic Act
RDC	Regional Development Council
RDCC	Regional Disaster Coordinating Council
RRA	Rapid Rural Appraisal
SIADs	Sub-Integrated Area Development Units
SRA	Social Reform Agenda
SW	Scope of Works
TESDA	Technical Education and Skills Development Authority
TLRC	Technology Livelihood Resource Center
TOR	Terms of Reference

Measurements

Length

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

Area

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

Volume

cm ³	=	cubic centimeter
l	=	liter
kl	=	kiloliter
m ³	=	cubic meter

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

Weight

g	=	gram
kg	=	kilogram
ton	=	metric ton

Currency

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

Time

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

Other Measure

%	=	percent
°	=	degree
°C	=	degree(s) Celsius
10 ³	=	thousand
10 ⁶	=	million
10 ⁹	=	billion
kmph	=	kilometer per hour

Energy

W	=	Watt
kw	=	kilowatt

Fiscal Year

January 1 to December 31

Exchange Rates

(in Master Plan as of July 1999)

US\$ 1 = PHP38.2

US\$ 1 = ¥122.4

(in Feasibility Study as of December 1999)

US\$ 1 = PHP40.0

US\$ 1 = ¥105