EXECUTIVE SUMMARY

(Part I : Master Plan)

CHAPTER 1 INTRODUCTION

1.1 Authority

This Study on Comprehensive Disaster Prevention around Mayon Volcano (the Study) is being carried out in accordance with the method and procedure proposed in the Inception Report which was duly consented by the Steering Committee in reference of the stipulation of the Implementing Arrangement (I/A) for the Study on Comprehensive Disaster Prevention around Mayon Volcano agreed upon between the Department of Public Works and Highways (DPWH) and the Japan International Cooperation Agency (JICA) on April 7, 1998.

The Final Report presents both the "Master Plan on Comprehensive Disaster Prevention around Mayon Volcano" and the results of "Feasibility Study" on the priority projects selected in the Master Plan. This Report incorporates all of the findings, survey and study results obtained through the field and home works so far made from October 1998 to October 2000.

1.2 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 the Government of the Philippines (GOP) in the course of the Study.

1.3 Scope of the Study

In accordance with the Implementing Arrangement agreed upon between both parties (GOP and JICA) and terms of reference (TOR) given by JICA, the Study centers on the "comprehensive disaster prevention", especially focusing prevention/mitigation, forecasting and warning, awareness raising, and evacuation and resettlement.

The disasters to be brought by hazards of “volcanic eruption”, “flood & debris flow” and "typhoon" are focussed in the Study in compliance with the TOR.

1.4 Study Area

The Study covers the surrounding areas around Mayon Volcano as shown in the Location Map. In this area, there are 7 river systems and 17 rivers including their tributaries, which are exposed to potential hazards and need disaster prevention analysis. Administratively, the Study Area concerns one city (Legazpi) and nine municipalities consisting of Bacacay, Camalig, Daraga, Guinobatan, Ligao, Malilipot, Malinao, Sto. Domingo, and Tabaco. The Study Area, which has a direct bearing on disaster prevention, is estimated to be around 908 km^2 in total.

1.5 Study Organization

Sixteen JICA experts listed in Table 1.1 (Main Report) have participated in the Study so far, and each of them worked together with his/her GOP counterpart personnel assigned by GOP during the Study period.

The GOP established a Steering Committee composed of members from DPWH and NEDA to steer the Study, as well as a Technical Working Group, which includes members from OCD, PHIVOLCS, DSWD, DENR, TLRC, etc, to extend day-by-day cooperation to the study term. On the other hand, an Advisory Committee was set up by JICA to provide the Study Team with advice on the Study implementation.

1.6 Study Performance

The Study started at the end of September 1998 with preparation of the Inception Report and is scheduled to be completed in July 2000 with submission of the Final Report. The Study is divided into Phase I for basic study and formulation of a Master Plan and Phase II for Feasibility Study on the priority projects & programs selected in the Master Plan. After submission of the Inception Report, the Study Team has prepared successively the Progress Report (1), Interim Report, Progress Report (2), Draft Final Report , and Final Report at the end of each major stage of the Study.

1.7 Logical Framework of the Study

The construction of a logical framework was attempted for Comprehensive Disaster Prevention Plan as described below:

1) The goal of the Comprehensive Disaster Prevention Plan is to "protect the life and property of the people living around Mayon Volcano and establish a sustainable comprehensive disaster prevention system".
2) The purpose of the Plan is to "reduce the vulnerability and strengthen the disaster prevention capacity" of the communities and their people, through taking the disaster prevention measures, both structural and non-structural, and incorporating disaster mitigation into specific area development projects.

The assumptions for achieving this goal and purpose are summarized in Table 1.5 (Main Report).

1.8 Transfer of Technology

In accordance with the "Technology Transfer Plan" prepared based on the results of discussion with the Philippine counterparts (agreed on October 30, 1998), the transfer of technology started in close cooperation and joint-work with the counterpart personnel, both the officers of DPWH Central and Region V offices and those from other government agencies like OCD, PHIVOLCS, DENR and NEDA. This transfer was done mainly through on-the-job training, technology transfer workshops and seminars, and these were successfully carried out (refer to the Main Report for more detailed information).

CHAPTER 2 ISSUES FOR COMPREHENSIVE DISASTER PREVENTION PLANNING

2.1 Issues Identified in the Past Events

The Study Area around Mayon Volcano is a disaster prone area with frequent eruptions of the volcano causing pyroclastic flows, ash-falls, etc., typhoons with strong wind and flood due to heavy rains. The volcano has erupted 47 times since 1616 through 1999, about every 8 to 10 years on average. After 8 months of intermittent restive behavior since June 1999, the volcano erupted anew (February and March 2000) in a series of explosions, and a state of disaster was declared in the area around the volcano.

Typhoons and floods occur every year and bring about destructive disasters to the regional economy. Noticeable disasters in the Study Area since 1993 to date are the eruption of the volcano in 1993 and 2000, and typhoons in 1993, 1994, 1995, and 1998.

The eruption of the volcano in 1993 caused damages amounting to about PHP 77.7 million with 77 deaths and 12,139 families affected (evacuees). While the Typhoon Loleng in 1998 brought about huge damages amounting to nearly PHP 2 billion with 3 deaths and more than 218,000 people affected. The problems pointed out in these disasters are summarized in the table of Section 2.1 (Main Report). Past records of these disasters leave valuable lessons to be learnt: i.e. what are insufficient and required in terms of manpower for disaster prevention, Sabo and flood control facilities and other infrastructures, funding, organization, information, institutions, etc.

2.2 Disaster Related Factors and Disaster Prevention Capacity

(1) Basic Concept on Disaster Prevention

Disaster stems from the fact that certain communities or structures are vulnerable to hazards. Thus, disaster may be logically given by the following equation:

Hazard x Vulnerability = Disaster

Disaster prevention capacity may be strengthened by mitigating magnitude of hazards and reducing vulnerability. Countermeasures considered in this Study can be 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.

Supporting programs are conceived in order to implement disaster prevention measures more effectively and sustain the disaster prevention capacity. Besides, the economic development in the area is necessary to generate a surplus fund for strengthening disaster prevention capacity including operation and maintenance of the projects to keep its sustainability.

(2) Socio-economic Development Framework and Coping Capacity

In 1973, the Legazpi City was designated as a "regional administrative center" and the regional offices of each government agency have been established in Legazpi. Since then, its economic development has been remarkably enhanced. There are many projects and programs of infrastructure construction and rural area development projects being carried out and schemed by the national government, LGUs and private fund sources as well as by foreign assistance. Considering such circumstances, it is expected that GRDP in 2020 will reach the target. Assuming that tax revenue increases accordingly, the respective LGUs will be able to share the required operation and maintenance cost.

CHAPTER 3 PRESENT CONDITIONS AND COPING CAPACITY

3.1 Physical Setting

(1) Topography and Geology

Mayon Volcano is located on the Bicol Peninsula in the southern part of the Luzon Island. Its topographical profile has an extraordinary symmetry as a konide type. Its summit is 2,462m above sea level. The gradient of mountain slope varies gradually from the summit to sea level. Mayon Volcano is classified as a strata volcano, consisting of deposits formed basically by four major types of volcaniclastic ejecta: lava flow, ash fall deposition, pyroclastic flows, and lahar flows.

(2) Meteorology and Hydrology

According to the climatological classification in the Philippines, the eastern part of the Albay Province belongs to Type II climate and the western part belongs to Type IV. The Study Area is characterized by an indistinct dry season and a very pronounced maximum rainfall period from September to January. The long-term mean annual rainfall observed from 1961 to 1995 at Legazpi Station of PAGASA is 3,354 mm. Total number of rainy days per year in Legazpi is measured as 221 days (60%) on average. According to the data on tropical cyclones that affected the Bicol Region during the period 1987-1996, 8.4 tropical cyclones pass over the region in a year on average. Albay Province including the Study Area has an average frequency of cyclone occurrence of one per year.

(3) Rivers around the Mayon Volcano

The following 7 river systems with 17 rivers were studied. Three major rivers, Yawa, Quinali (A), and Quinali (B), comprise several tributaries as shown below.

River Systems and Rivers Related to the Study Area

River System	River	Catchment Area (km^2)	River Length (km)
Yawa River System	Yawa	74.4	17.3
	Pawa-Burabod	7.6	11.6
	Budiao	7.5	11.8
	Anoling	9.4	10.2
Quinali (A) River System	Quirangay	9.3	9.8
	Tumpa	5.7	7.8
	Maninila	4.9	10.7
	Masarawag	10.5	12.2
	Ogsong	38.1	21.4
	Nasisi	84.2	20.9
Quinali (B) River System	Buang	4.5	8.3
	Quinali (B)	157.8	31.1
	San Vicente	9.9	13.3
Arimbay River System	Arimbay	2.6	5.3
Padang River System	Padang	7.6	9.3
Basud River System	Basud	14.0	11.0
Bulawan River System	Bulawan	15.4	11.5

(4) Eruption of Mayon Volcano and Related Hazard

Mayon Volcano is one of the active volcanoes in the Bicol volcanic chain, southeast Luzon. Pyroclastic flows were frequently discharged during historic eruptions and emplaced up to 10 km away from the summit crater. The Volcano has erupted 48 times during the period from 1616 to now. The latest eruption just recently occurred in February 2000 with a series of explosions and the state of disaster was declared in the area around it.

The past records on the occurrence frequencies of eruptive hazards indicate that most of eruptions initiate with the emission of ash falls and the eruption is not necessarily accompanied with dangerous pyroclastic flow and lava flow. The occurrence and visit of pyroclastic flow and lava flow are more frequent in the southern slope of the volcano as compared with its northern portion.

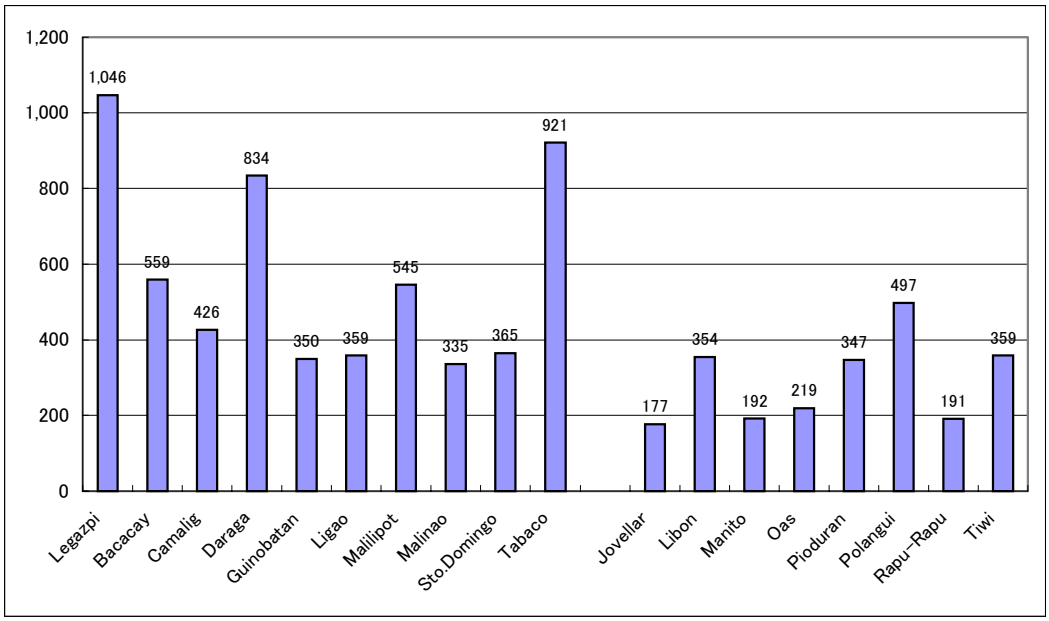
3.2 Socio-economic Conditions

(1) Socio-economy

According to the latest 1995 Census, the population of Albay Province was 1,005,255 and that of the Study Area was 672,508 or 66.9% of the provincial total. Based on the annual average growth rate of 2.33% during the period of 1990-1995, the present populations in the province and the Study Area are forecast to be 1,095,519 and 737,936, respectively. The population density of the province is

estimated at 430 persons per km^2 in 1999. This figure is relatively high compared with that of Bicol Region (266 persons/km^2) and the national figure (246 persons/km^2)

Population Density by City/Municipality in Albay Province, 1999



Source: Computed by the JICA Study Team, based on the 1990 Population Census and 1995 projected figures.

The GRDP of Bicol Region increased from PHP61,584 million to PHP81,923 million in 1999 prices by the average annual growth rate of 2.22% and per capita GRDP grew from PHP15,702 to PHP17,172 in 1999 prices in thirteen years during the period from 1985 to 1998. There are no available statistics with regard to the GRDP of Albay Province, so the JICA Study Team estimated on the basis of GRDP of Bicol Region and provincial socio-economic statistics in the region. According to the estimates, the GRDP of Albay Province increased from PHP18,845 million to PHP21,439 million in 1999 prices by 4.39% per annum. Its per capita GRDP grew from PHP18,819 to PHP19,947 in 1999 prices by 1.96% per annum in three years during the period from 1995 to 1998. (The details of methodology for estimates are described in the Supporting Report (1), Chapter XII, 4. Socioeconomic Framework)

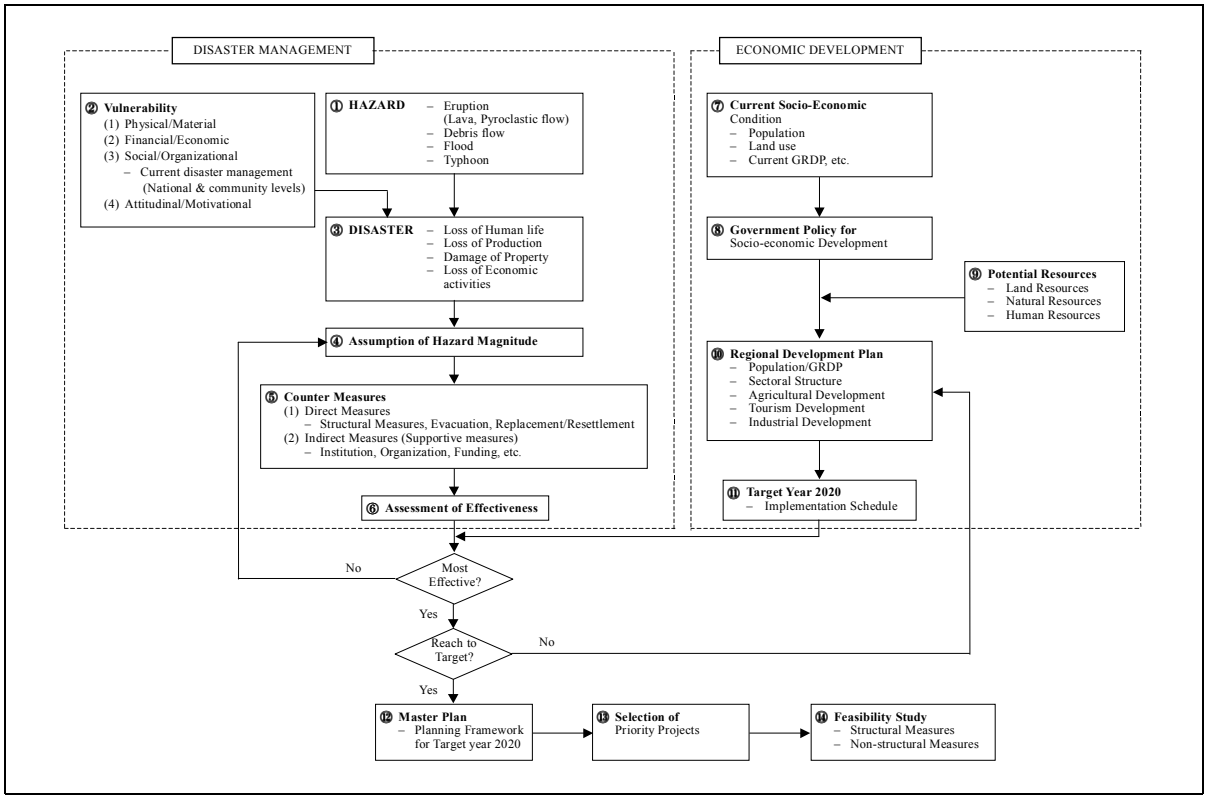
(2) Interrelation between Disaster Prevention and Economic Development

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 annual calamity fund released in two years of 1996-97 worked out at 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.

The JICA Study Team's view on interrelation on disaster management and economic development, and its study flow are shown in the following figure.

Interrelation between Disaster Prevention and Economic Development and Study Flow



(3) Infrastructure

As of 1975, Albay Province has a total road length of 976.2 km or road density of 0.383 km/km^2. The concern and trend for development of roads require for the concreting of national and provincial roads as well as its maintenance and rehabilitation of damaged road sections.

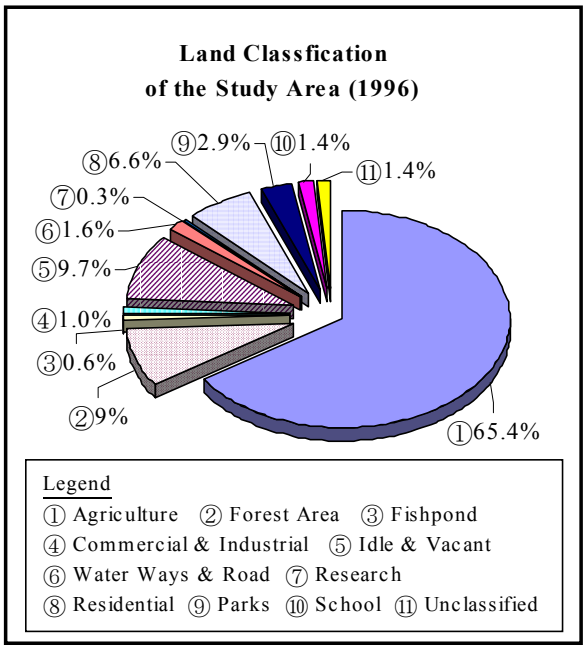
The province has one port of entry/international port (Tabaco Port), one sub-port of entry/national port (Legazpi Port), six municipal ports, four barangay ports.

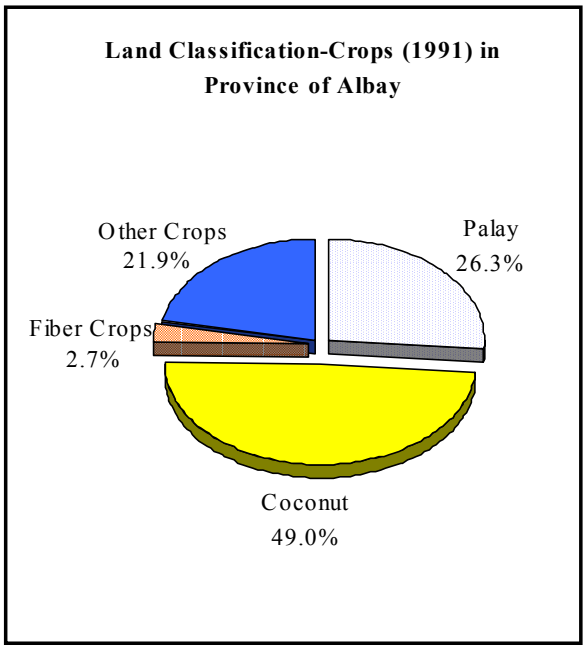
These ports have a vital role in the province's trade and commerce, and as one of the growth center in the region. The activities and roles of these major ports develop a tendency to increase steadily. Legazpi Airport is the only airport in the province. The existing domestic airport facilities need to upgraded and the existing runway needs to be expanded so as to meet its increasing number of passengers and cargo volumes.

Power generation and supply is an indispensable factor for regional development. Household electrification is provided by the Albay Electric Cooperative (ALECO). ALECO supplies 154,480 households in Albay Province, accounting for 82.3% of the provincial total. In the province, water is supplied with Level 3 gravity-fed or pressure-pumped system. The coverage of this Level 3 water system is estimated to be for about 39% of the total municipalities. As for the communications in relation to disaster management, the media (radio & television) and telephone play an important role, especially in preparedness (warning) and response (evacuation) phases.

(4) Land Use

The Albay Province has a total land area of 255,257 ha, or 2,552.6km^2. The Study Area consisting of 1 city and 9 municipalities covers 1,442.3km^2, which accounts for 51.6% of the provincial total. The province has a total coast length of 354km.

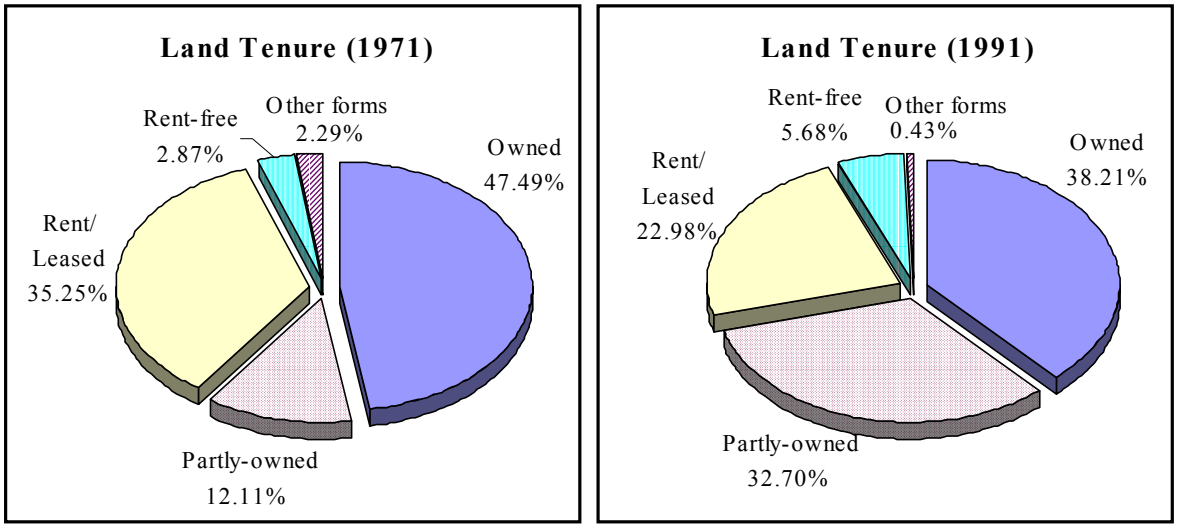




Sources: The Provincial Profile-Province of Albay 1996 and
The Census of Agriculture 1991- National Statistics Office.

The agricultural land is dominant in the province, 65.4% out of the total area. Coconut, palay and abaca are the major products in Albay, and these three crops occupy 78.1% of the total agricultural land, which is 55.3% of the total land of Albay.

The situation of the tenure of the farmland shows a significant change in the 20 years from 1971 to 1991 as well as the number of land-owners and the land size.



Sources: The Provincial Profile-Province of Albay 1996 and the Census of Agriculture 1991 – National Statistics

Most of these changes and tendencies are assumed to be the influence of the Agrarian Reform and this tendency of land size and tenure is expected to continue at least until 2004 which is the target year of the accomplishment of the Agrarian Reform.

Large scale land owners are few. The land owner who's land is less than 5ha occupies 93.17%.

The Province of Albay has drawn out a land use plan, entitled "Provincial Physical Framework Plan (PPFP)/Comprehensive Provincial Land Use Plan 1993-2002."

The following are the existing main issues for the land use planning.

1) Hazard Area by PHIVOLCS
   a. PDZ (Permanent Danger Zone): Area within 6 km-radius from the Volcano's crater (Permanent habitation not allowed/Off-limits to everybody, once eruption becomes imminent)
   b. HDZ (High Danger Zone): Area between 6 km to 10 km from the Volcano's crater (areas potentially prone to volcanic debris and mud flows)

2) Environmental Category
   a. Protection Land
      - SEA (Severely Eroded Area): Area subjected to severe erosion
      - NIPAS (National Integrated Protected Area), including the Mayon Volcano National Park
      - Non-NIPAS

   b. Environmentally Constrained Land
   - Area subject to natural hazard
   - Coastal zones
   - Network of Protected Areas of Agricultural Development (NPAAD)

3) Agricultural Category
   a. Agrarian Reform
   b. Food Security Plan and NPAAD
   c. Irrigation Project

4) Land Conversion and Expropriation

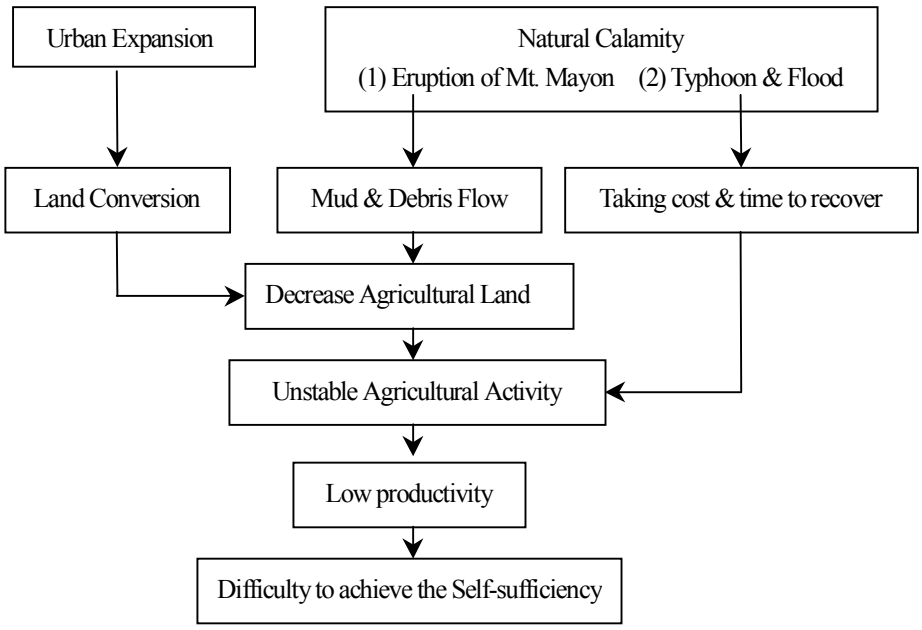
According to the "Revised Rule and Regulations on the Conversion of Agricultural Lands to Non-Agricultural Uses, 1999," the criteria of the land which can be subject to the land conversion is as follows[1].

   a. Not irrigated area
   b. Not Protected Area – NIPAS
   c. Not classified as the Agricultural Land in the LGU's land use plan

The problem structure over the land is illustrated below.

[1] 500m from the national road cannot be classified as agricultural land.

Problem Structure over the Land



(5) Environment

Disaster mitigation projects/programs are intended to improve living conditions in areas prone to natural hazards. As such, it is expected that the benefits derived from these projects should far outweigh any negative impacts that may result from the activities associated with their implementation.

In this Study, an IEE was carried out to address the potential impacts of possible structural and non-structural measures especially to the socio-economic environment. The most critical issue is the relocation/resettlement of the people living within a 6 km-radius from the crater of Mayon Volcano (or Permanent Danger Zone) and that due to implementation of the structural projects which include construction works of sand pockets, dikes, Sabo dams, and so on.

3.3 Institutional Aspect

(1) Institutional Framework for Disaster Prevention

Local administration bodies in the Philippines have four tiers: region, province, city and municipality, and barangay. The numbers of the respective administrative divisions are as follows.

Administrative Divisions	Bicol Region	Albay Province	Study Area
Region	1	N/A	N/A
Province	6	1	N/A
City	3	1	1
Municipality	112	17	9
Barangay	3,471	720	446

Note: N/A = Not Applicable
Source: The Philippine Statistical Yearbook 1998, NSCB

The Presidential Decree (PD) 1566 issued in 1978 is a primary legislation, which frames the national disaster management in the Philippines. This PD calls for the Philippine disaster control capability and national program on community disaster preparedness. The major provisions stipulate for:

- state policy on self-reliance among local officials and their constituents in responding to disasters;
- organization of National, Regional, Provincial, City/Municipal and Barangay Disaster Coordinating Councils (DCCs);
- preparation of the "National Calamities and Disaster Preparedness Plan" by the OCD and implementing plans by the NDCC member-agencies and local DCCs;
- conduct of periodic drills and exercises by concerned agencies and local DCCs; and
- authority for local government units to program funds for disaster preparedness such as the organization of DCCs, establishment of Disaster Operations Center and training and equipping of DCC response teams.

"Rules and regulations implementing the provisions of PD1566" defines the responsibility of each agency so tasked under the Decree.

At the provincial level, a Provincial Disaster Management Office (PDMO) was established in 1995 as an independent department. This PDMO is the technical arm and acts as a secretariat of the Provincial Disaster Coordinating Council (PDCC). In every city and municipality of the Study Area, a Disaster Coordinating Council (DCC) is organized and most of them have disaster preparedness plan, even though these plans only mainly consist of an organization chart and simple explanation of the roles of the C/MDCC members.

(2) Financial System for Disaster Prevention

At the national level, main budgetary source for rehabilitation, reconstruction and other works in connection with calamities is "(national) calamity fund" managed by NDCC Secretariat and released by the approval of the President.

According to the NDCC data, the total amount of damages to crops and infrastructures amounted to PHP 24,967 millions in 1998. This national calamity fund consists of three uses or programs for: (a) quick response, (b) local government units, and (c) disaster preparedness.
Request for calamity fund is made by disaster coordinating councils at various levels. In most cases, the calamity fund is disbursed for large scale disasters. The following table presents amount of calamity fund released and total damages caused by major disasters in the Philippines.

Year	Cost of Damages (Million Pesos)	Calamity Fund Released	
		(Million Pesos)	Calamity Fund/Cost of Damages (%)
1996	3,113.8	907	29.1
1997	1,312.1	340	25.9
1998	24,967.0	968	3.9

Source: The Philippine Statistical Yearbook 1997 - 1999

As seen in this table, national calamity fund amounts to around a quarter of the damages by major disasters. (For 1998, damages accrued from Typhoon Loleng that struck the Philippines in October were included. Some parts of calamity fund may have been released in the following year.)
Local Government Code of 1991 provides that 5% of LGU's budget shall be earmarked each year as calamity reserve. The calamity reserve is mostly used for emergency rescue and rehabilitation. The aggregate amount of calamity reserve for Legazpi City and 9 municipalities and Albay Province was 4.2 million pesos in 1998. The amount of damage for public buildings by Typhoon Loleng was 200 millions pesos. Thus, the current appropriation of calamity reserve is not sufficient for a large-scale disaster like Typhoon Loleng. In addition to the calamity fund, LGUs are used to set aside 20% of allocated IRA as "Development Fund". This development fund is used for infrastructure development projects in each of LGUs.

(3) Infrastructure Investment Program

In the "Philippine National Development Plan" or Vision for the 21st century, the Philippine Government lays an importance on the approach to the flood control

and drainage with two measures, namely structural and non-structural. The structural measures concern construction or rehabilitation of the dikes, levees, sand pockets, floodways, etc., while the non-structural measures are related to establishment/development of flood forecasting and warning system, flood zoning and reforestation.

The public investment achievement for Bicol Region was PHP19.3 billion in 1998. The total amount for flood control and drainage was PHP170.1 million, accounting for 8.8% of the total public investment in the Region. The annual average public investment (1993-1998) for Albay Province worked out at PHP185.9 million, whereas those for flood control and drainage amounted to only PHP52.9 million or 28.5% of the total public investment while 117.8 million or 63.4% were allocated for Highways.

3.4 Sabo Facility

Sabo and Flood Control Projects

Based on the inventory survey, the Sabo and flood control facilities constructed so far in the17 rivers are as follows.

Existing Sabo Facilities on Each River in the Study Area

River	Existing Facilities (Total Number and Total Length)	Existing Condition
Yawa	Boulder Dike (7 dikes, 3,078m)	Good
Pawa-Burabod	Spur Dike , Training Levee (13 dikes, 6,496m) , Consolidation Dam (1)	Partially damaged
Budiao	Spur Dike , Training Levee (6 dikes, >5,135m)	Partially damaged
Anoling	Spur Dike , Training Levee (7 dikes, 1,850m) , Ground Sill (1)	Good
Quirangay	Spur Dike , Training Levee (10 dikes, 3,305m) , Consolidation Dam (1)	Good
Tumpa	None	No facility
Maninila	None	No facility
Masarawag	Spur Dike , Training Levee (8 dikes, 1,700m)	Good
Ogsong	Spur Dike (2 dikes, 80m)	Good
Nasisi	Ground Sill (3 dikes, 565m) , Consolidation Dam (2)	Good
Buang	None	No facility
Quinali (B)	None	No facility
San Vicente	Spur Dike (6 dikes, >770m)	Need to rehabilitate
Arimbay	Spur Dike (8 dikes, 2,680m), Consolidation Dam (1)	Good
Padang	Spur Dike (7 dikes, 2,340m)	Partially damaged
Basud	Spur Dike (15 dikes, 2,913m), Consolidation Dam (1)	Partially damaged
Bulawan	Spur Dike (9 dikes, 3,493m) , Consolidation Dam (1)	Partially damaged

3.5 Flood Control Facility

River Improvement Projects

In the Re-Study of Mayon Volcano Sabo and Flood Control Project in 1983, the river improvement works were also planned and proposed for the three rivers of Quinali (A), Quinali (B), and Yawa rivers, but they were not duly implemented. The following table shows the existing river improvement works carried out by DPWH.

Present Condition of River Improvement Works by DPWH

River System	River Name & Location	Facility Name	Height (m)	Length (m)	Date of Completion	Existing Condition
Yawa	Yawa Legazpi City	a. Boulder Dike	4.00	320	14 Feb. 1989	Good
		b. Boulder Dike	4.00	1,200	2 June 1991	Good
		c. Boulder Dike	4.00	1,250	1 Nov. 1989	Good
		d. Dike No. 1,2,3,4	4.00	308	N/A	Partially damaged
Quinali (B)	San Vicente	a. Boulder Dike No.1	4.00	115	22 Dec. 1990	Need to rehabilitate
		b. Boulder Dike No.2	4.00	115	22 Dec. 1990	Need to rehabilitate
		c. Spur Dike No.1	4.00	240	N/A	Need to rehabilitate
		d. Spur Dike No.2	4.00	240	N/A	Need to rehabilitate

3.6 Flood Forecasting, Warning and Evacuation

(1) Forecasting and Warning

In relation to improvement and strengthening of the forecasting and monitoring system, the Study focused on the following hazards:

Cause of Hazard	Hazards
- Eruption	・ Pyroclastic flow (including ash fall) ・ Lava flow
- Rainfall	・ Mud and debris flow ・ Flood ・ Inundation
- Tropical depression	・ Wind

The forecasting, monitoring, and issuing of warning with regard to these hazards are entrusted to the following agencies:

- Volcanic eruption (pyroclastic and lava flow) : PHIVOLCS
- Typhoon : PAGASA
- Mud and debris flow : Not assigned
- Rainfall and river water level : PAGASA

Existing forecasting and warning systems comprises the following facilities;

- Eruption : 4 seismograph, EDM, Gas analyzer
- Rainfall : 5 event report telemeter
- Typhoon : GMs,
- Warning : VHF radio, Public telephone, broad casting radio TV

All warnings issued are firstly conveyed to the City and/or Municipal Disaster Coordinating Council (C/MDCCs) from the respective agencies. Then, C/MDCCs transfer this warning to Barangay DCCs through house-to-house visit. The respective agencies inform the warning to the Provincial DCC as well for monitoring and supporting for the emergency response. On the other hand, the respective agencies or DCCs disseminate the warning to public through mass media such as radio and TV broadcastings.

(2) Evacuation

The City, Municipality and Barangay Disaster Coordinating Councils are responsible for matters pertaining to evacuation, as stipulated in the provisions of PD 1566. The Regional and Provincial Disaster Coordinating Councils extend logistical support to complement the efforts of the lower DCCs concerning evacuation.

In 1998, a total of 209 evacuation centers in the Study Area were listed by PDMO. These evacuation centers are used for accommodating the people affected by calamities like volcanic eruption, typhoon, and flood. Since the identified evacuation centers are not really intended to provide temporary shelter to the evacuees, the available facilities are insufficient to meet the needs of the evacuees creating discomfort specially among the social weak.

3.7 Relocation and Resettlement

There are at present six resettlement sites in the Study Area which are located in Legazpi City (Banquerohan Phase I: 18ha), Camalig (Batawon), Daraga (Salvacion), Guinobatan (Quitago), Ligao (Baligang) and Tabaco (Buang). These resettlement sites were constructed after the eruption of the Volcano in 1993 under the joint cooperation of the LGUs, government line agencies and other donor organizations. Total number of the families presently residing in these sites is estimated at 960 households.

Existing and Planned Resettlement Sites in the Study Area

No.	Name	Location (City/Municilality)	Distance from Crater (km)	Land Area (ha)	Establish-ment (Year)	No. of Houses
1.	Baligang	Baligang, Ligao	7	0.35	1993	45
2.	Banquerohan	Banquerohan, Legazpi	20	Phase I: 18 Phase II: 27	1994	504
3.	Batawon	Tagaytay, Camalig	12	9.8	1995	480
4.	Buang	Buang, Tabaco	8	1.0	1993	22
5.	Quitago	Quitago, Guinobatan	14	0.8	1988	30
6.	Mi-isi	Salvacion, Daraga	8.5	1.7	1994	135
7.	Anislag	Anislag, Daraga	15	(22)	(1999-)	(635)
8.	San Andres	San Andres, Sto.Domingo	10	(17)	-	(569)
9.	San Vicente	San Vicente, Tabaco	11	(56)	-	-
10.	Sta. Teresa & San Isidro	Sta Teresa & San Isidro, Malilipot	9	(30)	-	(40)

Note: Figures in parentheses are “planned”. The mark (-) signifies “not yet decided”.
Source: Data from the city and municipal authorities concerned.

Although these families were relocated, their main source of income remains to be from cultivation of their lands that are located within the danger zones of Mayon Volcano. The resettled families consider job creation as the most important activity that should be implemented in any resettlement program. In addition to the Banquerohan expansion plan (Phase II: 27 ha), there are four new resettlement development schemes which are envisioned to provide housing to affected and poor families in the Municipalities of Daraga (Anislag), Sto. Domingo (San Andres), Tabaco (San Vicente) and Malilipot (Sta. Teresa, San Isidro Iraya and San Isidro Ilawod).

CHAPTER 4 CONCEIVABLE IMPROVEMENT PLAN OF COPING CAPACITY

4.1 Scenario to Realize the Per Capita GRDP Set at the Target Year of 2020

(1) Population Projection

The population of the Study Area is around 700 thousand in 1995 and is forecasted to increase to more than 1 million in 2020 as a target year. The annual growth rate of the population of the Philippines is expected to be 1.75% per annum and the one of the Study Area will be 1.64% per annum.

Population Projection

(Unit: Person)

Area Division	1995	2000	2005	2010	2015	2020
Study Area	698,565	756,892	820,574	890,142	966,182	1,049,345
Albay Province	1,001,387	1,108,015	1,213,176	1,318,417	1,417,701	1,505,701
Bicol Region	4,309,488	4,755,076	4.161,007	5,541,343	5,904,788	6,207,492
The Philippines	68,349,452	76,348,114	84,241,341	91,868,309	99,015,818	105,507,209

Sources: 1. Population projection for Nation, Region and Province is based on 1995 Census.
2. JICA Study Team conducted population projection for the Study Area.

Average Annual Growth Rate of Population

(Unit: %)

Area Division	1995/2000	2000/2005	2005/2010	2010/2015	2015/2020	1995/2020
Study Area	1.62	1.63	1.64	1.65	1.67	1.64
Albay Province	2.04	1.83	1.68	1.46	1.21	1.64
Bicol Region	1.99	1.65	1.47	1.24	1.00	1.47
The Philippines	2.24	1.99	1.75	1.41	1.28	1.75

Sources: 1. Population projection for Nation, Region and Province is based on 1995 Census.
2. JICA Study Team conducted population projection for the Study Area.

(2) Outlook of Economic Structure

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 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 important factors for such a low level of economic growth can be guessed to be the extremely low investment to disaster prevention in the past and not to contribute to fundamental solution for disaster prevention and, as the result, to decelerate considerably the economic growth by the development plans. This point can be easily observed from the relation among the public investment, the damages by disasters and GRDP in Albay Province including the Study Area during the recent three years (1995 to 1998).

Recent Performance for Public Investment, Damages by Natural Disasters and GRDP in Albay Province and the Study Area (1993-1998)

(Unit : Million Peso)

		1993	1994	1995	1996	1997	1998	Total
Public Investment (Albay Province)	1. Highways	1.9	9.8	459.6	20.3	103.6	111.8	706.9
	2. Flood Control and Drainage	-	29.4	209.9	13.0	26.4	38.8	317.6
	3. Water Supply	-	10.5	53.2	-	-	-	63.7
	4. Urban Infrastructure	-	-	2.4	-	-	-	2.4
	5. Various Projects	0.2	7.1	17.7	-	-	-	24.9
	Total	2.1	56.8	742.7	33.3	130.0	150.6	1,115.4
Damages (Albay Province)		77.6	215.0	2,271.0	-	-	1,990.0	4,553.6
GRDP (at Constant 1999 Prices)	Albay Province	17,166	17,990	18,854	19,759	20,707	21,439	115,916
	The Study Area	12,636	13,242	13,878	14,544	15,242	15,781	85,324
Ratio to GRDP(%)								
(1) Total Public Investment	Albay Province	0.0	0.3	3.9	0.2	0.6	0.7	1.0
	The Study Area	0.0	0.0	5.4	0.2	0.9	1.0	1.3
(2) Investment for Flood Control & Drainage	Albay Province	-	0.2	1.1	0.1	0.1	0.2	0.3
	The Study Area	-	0.2	1.5	0.1	0.2	0.2	0.4
(3) Damages	Albay Province	0.5	1.2	12.0	-	-	9.3	3.9
	The Study Area	0.0	0.3	16.4	-	-	12.6	5.3

Notes: 1. The amounts for disaster prevention works are included in the sub-sector of "Flood Control and Drainage".
2. The amounts of damages is based on major damages caused by erruption in 1993, typhoon: "Akang" and "Garding" in 1994, "Rosing" in 1995 and "Loleng" in 1998.
3. GRDP was estimated by the JICA Study Team.

Source: 1. The public investment: Department of Public Works and Highways (DPWH), Region-V
2. The damages: PDCC/PDMO and Survey on Calamities and Casualties by Flood and Debris Flow, Final Report, March 1999.

According to the above table, the amounts of investment for the flood control including the disaster prevention and the drainage is only one third of all public investments as 317.6 million peso though 1,115.4 million peso was invested as the public investment during the six years. On the contrary, the two times of the disaster prevention investment as 706.9 million peso was invested for the highways. Looking at the ratio of the public investment

to GRDP, the public investment is 1% for Albay Province and 1.3% for the Study Area. The investment for the flood control and drainage are less than 1.0% both for Albay Province and the Study Area. Then it is assumed that the direct investment for the disaster prevention is far less than those of flood control and drainage.

During the six years, the damages by disasters reached to 1,154.4 million peso and their ratios to GRDP is 4.0% for Albay Province and 5.3% for the Study Area.

It is very clear from the above observation that the damages have increased very rapidly than the public investment, especially, the investment for flood control and drainage which ought to accelerate the disaster prevention and the economic growth and then GRDP has increased at the very low growth rate as a result.

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 Previous Measures

(Albay Province)

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 in the past.

(The Study Area)

GRDP growth rate by industrial origin was set for City/Municipalities in the Study Area as set for Albay Province.

Case with Disaster Prevention Measure

As the result of study on the relations among GRDP, investment costs 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.

(Albay Province)

- The assumptions for average annual growth rate by sector during the period from 1998 – 2005
  - Agricultural Sector: The natural growth rate is set up on the basis of the annual average growth rate of agricultural sector of Albay Province during the period from 1995 to 1998. The development growth rate is set up on the basis of growth rate of agricultural productivity assumed in the medium-term economic development projects of ODA, Albay Province and Legazpi City/Municipalities during the period from 1999 to 2004.
  - Industry/Service Sector: The natural growth rate is set up on the basis of the annual average growth rate by sector during the period from 1995 to 1998. The development growth rate is set up by calculating the amounts 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 assumptions for average annual growth rate by sector during the period from 2005 - 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 of Albay Province on the basis of growth rate during the period from 1998 to 2005 and the growth rate of share by sector of regions with high growth rate (like Region III and IV).

(The Study Area)

GRDP growth rate by sector of City/Municipalities, which are belonged to the Study Area, is set up on the same method as of Albay Province for the period from 1998 to 2005 and the period from 2005 to 2020. With regard to GRDP during the period from 1998 to 2005, the growth rate of economic development plans of industrial sector proposed in the Study in estimated in order to confirm the degree/possibility of achievement of the targeted GRDP in the Study Area..

Increase by Development Plan

(Unit: Million US$)

Plan	Annual Production
Abaca Handicraft Production	0.6
Pili Nut Processing	1.8
Coco Coir Production	12.4
Hollow Block Production	0.4
Aggregate Production Plant	1.2
Mineral Water Production	2.7
Sabo and Related Projects	20.6
Supporting Projects	2.4

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

The result of estimates of achievable per capita GRDP for the Study Area were estimated in both cases of without- and with- disaster prevention measures as follows.

Table for GRDP Target and Achievement for the Study Area
(without Disaster Prevention Policy)

(Unit: Milli. Peso)

Sector	Agriculture	Industry	Service	Total
1. Targeted GRDP (Low Growth Scenario)				
- 2005	3,178	10,859	14,326	28,363
- 2020	4,308	55,928	70,110	130,347
2. Scenario for achievable GRDP				
(Annual Average Growth Rate : %)				
- 2005	0.9	5.4	4.6	4.4
- 2020	0.9	5.1	4.6	4.4
3. Achieved GRDP				
- 2005	2,459	8,255	10,573	21,286
- 2020	2,798	17,371	20,652	40,821

Table for GRDP Target and Achievement for the Study Area
(with Disaster Prevention Policy)

(Unit: Milli. Peso)

Sector	Agriculture	Industry	Service	Total
1. Targeted GRDP (Low Growth Scenario)				
- 2005	3,178	10,859	14,326	28,363
- 2020	4,308	55,928	70,110	130,347
2. Scenario for achievable GRDP				
(Annual Average Growth Rate : %)				
- 2005				
* Natural growth	0.5	2.7	2.5	
* Growth by development	3.9	6.2	6.6	8.3
* Total	4.4	8.9	9.2	
Case with Industrial Development Plan and the Projects proposed in the study				
*Natural growth	0.5	2.7	2.5	
*Growth by development	7.0	5.8	4.3	7.5
*Total	7.5	8.5	6.8	
- 2020				
*Natural growth	0.5	2.7	2.5	
*Growth by development	4.7	8.7	9.2	10.9
*Total	5.2	11.4	11.7	
3. Achieved GRDP				
- 2005	3,361	10,733	14,115	28,209
Case with Industrial Development Plan and the Projects proposed in the study	3,749	10,164	12,259	26,173
- 2020	6,614	59,196	74,016	139,826

Note: GRDP by Development Projects include synergy effects.

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

(Unit: Peso and US$)

Disaster Prevention Measures	Target (A)		To be Achieved (B)		(B)/(A)
	Peso	US$	Peso	US$	(%)
Without	34,565	897	25,941	673	75.1
With			34,377	892	99.5
Case with Industrial Development Plan and the Projects proposed in the study			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: Peso 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 2005, per capita GRDP is supposed to reach its target almost 100%. The achievement ratio to the target GRDP in case of Industrial Development Plan and the projects proposed in the Study is 92.3%, which calculated to justify the reliability of achievable target. It doesn't include the industrial production cost and the investment for the infrastructure. Target GRDP will be achieved if these investment and industrial production cost are included in calculation.

In case of 2020, it is obvious that the achievement ratio to the target in case of "without disaster prevention measures" is extremely lower than the one of "with disaster prevention measures" of which the achievement ratio to the target is only 30%. In this context, it is rational to stress that the disaster prevention measures which are proposed in this Study are essential to be integrated as a part of the regional development plans to promote the sustainable development for Albay Province including the Study Area.

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 as the following table as one example

On the basis of assumption that the rate of development budget to the internal revenue allotment (IRA) is 20% and the rate of the flood control budget to the development budget 30% (the average annual growth rate during the period from 1993 to 1998), Legazpi City and Daraga Municipality would be able to burden enough the operating and maintenance cost by the flood control budget in the target year of 2020 for a long-term. In the target year of 2005 for a short-term, Legazpi City would be possible to burden enough the operating and maintenance cost (12 million pesos) by its flood control budget (4 million pesos). But judging from the financial situation of Daraga Municipality that the development budget (15 million pesos) as a source of flood control budget exceeds the operating and maintenance cost by revising the allotment rate of the development budget to flood control budget or by the subsides by the national Government and/or loan from financial institution.

Judging from the discussion above, it became clear that the targeted per capita GRDP is achievable and as a result of it, the economic surplus of local residents and the financial surplus of LGUs by the increase of development budget and flood control budget will make LGUs possible to burden the operating and maintenance cost of the projects. It appears that both the sustainable disaster prevention measures and economic development will be achieved.

Summary Table for Financial Affordability of Legazpi City and Daraga Municipality
(With Disaster Prevention Policy)

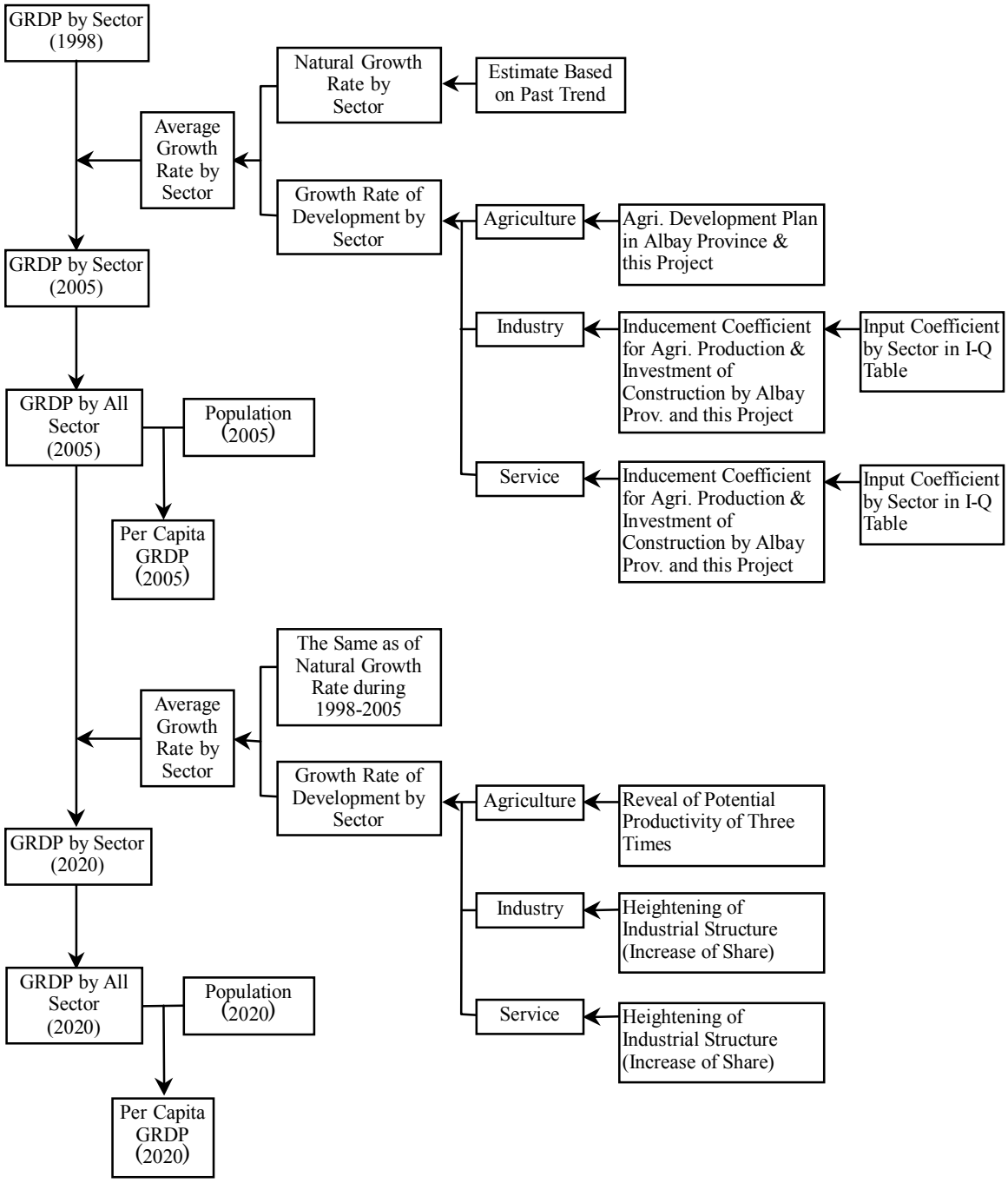
(Unit: Milli. Peso)

1. Revenue of Local Government (Increase of Tax Revenue)			
- 2005		Legazpi City	Daraga Muni.
* Total Revenue (IRA+Local Tax)	:	417	94
- IRA	:	327	73
- Tax	:	91	21
* Development Budget (29% of IRA)	:	**65**	**15**
* Flood Control Budget (15% of Dvt.B.)	:	**10**	**2**
- 2020			
* Total Revenue (IRA+Local Tax)	:	2,297	456
- IRA	:	1,798	353
- Tax	:	499	103
* Development Budget (29% of IRA)	:	**360**	**71**
* Flood Control Budget (15% of Dvt.B.)	:	**54**	**11**
2. Necessary O/M Cost for Priority Projects			
- 2005	:	**13**	**12**
- 2020	:	**13**	**12**

Note: O/M cost in this analysis includes Yawa River System, Sabo Project and Legazpi City Urban Drainage and Resettlement Site Development in F/S Priority Projects

The flow-chart of scenario for achievement of the GRDP target is shown in the following figure.

Scenario to Achieve the Targeted Per Capita GRDP of the Study Area



4.2 Basic Concepts and Strategies for Formulating a Comprehensive Disaster Prevention Plan

(1) Objective and Approach for Master Planning

The objective of the Master Plan Study on Comprehensive Disaster Prevention is to formulate a framework plan to impede/prevent the occurrence of disasters and mitigate their effects with a view to avoiding loss of life and reducing damages to properties in the areas around Mayon Volcano. The proposed Master Plan comprises disaster prevention projects and programs, which aim to challenge and overcome the problems/constraints clarified in Master Plan Study. These projects and programs are to be formulated in line with the government development policy and strategies for sustainable socioeconomic development.

(2) Direct Disaster Prevention Measures

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

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

The basic direction and typical activities of the respective three development strategy alternatives are compared as summarized below.

Comparison of Three Countermeasures

Characteristics	Countermeasure I (C-I) **Prevention & Mitigation**	Countermeasure II (C-II) **Evacuation**	Countermeasure III (C-III) **Relocation and/or Resettlement**
Basic Strategy	To impede/prevent the occurrence of a disaster event and/or reduce its harmful effects on key installations or communities	To remove persons from a disaster-stricken area into safer, better surroundings and conditions, and/or protect disaster-threatened persons from the full effects of the disaster	To relocate and/or resettle the communities, groups or individuals living in the highly dangerous areas, where disasters occur repeatedly
Typical Activities	- Construction of disaster prevention infrastructure like Sabo dams, dikes, etc., and installation of forecasting and warning facilities - Enforcement of land use regulations and imple-mentation of agricultural programs to cope with disasters, etc.	- Information management (forecasted & warning information) - Public cooperation & movement assistance - Preparation of evacuation centers (adequate accom-modation) - Logistic support - Arrangements for return	- Construction of basic social infrastructure such as houses, roads, water & electric supply system, etc. - Community development - Livelihood support

In formulating the Master Plan projects and programs, a combination of three coping strategies or countermeasures are proposed in each area, river system or river, and the projects and programs are placed in order of priority considering the disaster experiences in the past as well as respective local circumstances.

(3) Supporting Programs or Indirect Countermeasures

To ensure sustainable operations and management of the Master Plan projects and programs, "supporting" measures or programs are taken up and proposed as a package with the structural projects, primarily centering on institutional strengthening, appropriation of necessary funds, transmission of accurate and timely information, awareness raising, and so on.

4.3 Basic Disaster Prevention Strategies

(1) Sabo Planning

Basic concept for Sabo planning around Mayon Volcano is itemized as follows:

- Eruptive magnitude to be treated by a Sabo facility is assumed to be that produced by the 1984 eruption. A large-scale collapse of the volcano edifice is not assumed in this Sabo planning.
- Existing structure and alignment of Sabo facility (limited to hard and strong structure only) will be considered and utilized positively in this planning.

- Natural undulation on slope landform will be considered. For example, lava flow mound can be utilized as natural barrier to perform in part of a large dike.
- Sabo planning will adapt to changeable river course, landform changes and increase of runoff volume by the future eruption.
- Changeable channel course will develop on fan surface.
- New channel will form by deposition of pyroclastic flow or lave flow.

Selection criteria and protection area for Sabo planning for each river is summarized as follows:

Criteria and Protected Area for Sabo Planning

River	Area and Object to be Protected	Criteria for Sabo Planning
Yawa River System	Legazpi City area, Yawa main river, railway, Cagsawa ruins, National road	All debris material must be trapped by structure measure in upstream area to main river to protect efficient property in/around city area.
Arimbay River	No action plan since the drainage area disappeared by lava flow from the 1993 eruption	
Padang River & Basud River	National road, Barangay	There are some parallel tributaries next to target rivers. Debris material should be converged into one channel and flowed out to the ocean or deposit field safely and directly.
Bulawan River	National road, Malilipot	Countermeasure concept for the downstream area is the same to Padang river and Basud river. On the upstream area, it is possible that one tributary of Bulawan river will capture Tabigyan river. Facility planning should protect this piracy phenomenon.
San Vicente River & Buang River	National road, Barangay, River improvement in plain area	All debris material should be trapped by structure measure in upstream area from the national road. Or only property of Barangay should be protected by another structure.
Nasisi River & Ogsong River	No action plan is contemplated since protection area located far away for downstream area. Fan area should be utilized as natural retarding basin.	
Quinali (A) River System	National road, Barangay, Paddy field, Railway	Debris material should be gathered into main channel and flowed down between barangays and the paddy field safely.

(2) River Improvement Planning

Conditions and Criteria

Planning for river improvement in the Study Area is carried out on the basis of the following conditions and criteria.

1) Heavy rainfall

   Mean annual rainfall is estimated to be 3,000 mm at lower elevation such as Legazpi and Tabaco, and 4,000-5,000 mm at higher elevation over slopes of the Mt. Mayon. Daily maximum rainfall ranges 200-300 mm at lower elevation and 400-700 mm at higher elevation.

2) Year-round soil moisture

   Total number of rainy days is 221 days or 60% of the year on average in Legazpi. The relative humidity is almost constant through the year and annual mean is 83% at Legazpi.

3) Steep sloped channel

   The channel slope of the rivers around the Mayon Volcano is very steep. Average river bed slopes of mudflow channel and flood flow channel (such as Yawa, Quinali (A) and Quinali (B)) are 0.06-0.26 and 0.003-0.004, respectively.

4) Steep sloped drainage area

   The river basins are draining from the mountain top of the Mayon Volcano (EL 2,400m). Therefore, river piracy caused by mudflow events had frequently occurred, especially in the rivers of the southeast slope. Flash floods with very short duration time (25 - 130 min.) occurs in each river basin.

5) Sediment transport

   The river bed materials survey revealed that average particle sizes (D50) of the river bed materials are 13.0mm in the sediment flow portion and 0.4 mm in the flood flow portion.

6) Intensive land use

   Paddy fields are dominant land use in the flood flow portion of the rivers. In particular, the lower reaches of the Nasisi, Ogsong, Quinali (B), and San Vicente rivers are fully utilized for rice production.

   National road network is installed around the Mayon Volcano. The road system is passing the rivers to be considered with bridges.

7) River related facilities

   River improvement plan should carefully be studied taking into consideration the above river related facilities such as irrigation and drainage system and bridges in the river basins.

8) Alignment for planning

Riverbed of the flood flow portion is rather stable, and the extreme riverbed aggradation or degradation is not observed in the flood flow portion. Therefore, general alignment of the improved river sections will follow the original river courses. Partial river improvement works have been undertaken by DPWH, Region V in the Yawa, Quinali (B), Nasisi, Ogsong, and San Vicente rivers in the recent past.

(3) Urban Drainage Planning

Conditions and Criteria

1) Heavy rainfall

The same conditions as given in the river improvement planning.

2) Topography

Legazpi City is situated in a low-lying area and some areas in the central district are below sea level.

3) Insufficient drainage capacity

Main river channels functioning as an estero for urban drainage in the Legazpi City are: Macabalo River in the south and Tibu River in the north. Flow capacities of the main river channels are suitable up to 5-year flood peak. But, drainage capacities of secondary and tertiary channels are presently insufficient.

4) Insufficient maintenance

Insufficient maintenance causes flood inundation in the city as described below.

- Absence or inadequacy of drainage structures to properly train or guide the flow of rainwater to natural receptacles or water bodies
- Siltation or clogging in some drainage pipes because of inadequate maintenance
- Dumping of solid and liquid waste in natural and man-made channels which lessen their conveyance capacity
- Construction of subdivisions or housing developments in nearby areas without adequate drainage outflow connection

5) High tide

The extreme high tide was measured as 1.8m in the past. The coincidence of high tide and flood events has occasionally caused inundation in the city proper. Therefore, needs for installation of floodgates and pumping facilities are raised by Legazpi City.

6) Design flood

Design flood for urban drainage projects is recommended to be a 10-year flood in the Philippines and also adopted to the study. Probable flood for Macabalo and Tibu rivers is roughly estimated by rational formula.

(4) Forecasting, Warning and Evacuation Planning

1) Forecasting and Warning System

In the light of the current constraints, the proposed basic strategy for planning of forecasting and warning is to improve the accuracy and reliability of monitoring, forecasting and assessment through installing systems and establishing their network as follows.

a. Eruption of Volcano
   - Monitoring of magma
   - Monitoring of slope deformation
   - Monitoring of SO_2 gas

b. Flood and Inundation
   - Monitoring of rainfall
   - Monitoring of river water level

c. Mud and Debris Flow
   - Monitoring of rainfall
   - Monitoring of river water level
   - Sensing of discharge of mud and debris flow
   - Sensing of tremor of ground by mud and debris flow
   - Sensing by acoustic emission by mud and debris flow

d. Typhoon
   - Monitoring of magnitude
   - Monitoring and forecasting of travelling course

e. Inter Agency Disaster Information System

Selection of Candidates

The selected candidate systems constitute the forecasting, warning and evacuation system of the proposed disaster prevention master plan. The criteria adopted to assess the candidate system are as follows:

Technical reliability	(accuracy in forecasting and reliability in warning) Accuracy and reliability should be sufficient for evacuation and disaster fighting activity
Compliance to needs	(lead time and quick response) Since the system is to furnish a reliable information for evacuation and disaster fighting activity, the system should afford sufficient lead time, and accurate and quick judgement for those activities.
Availability	(existing infra-structure and system) The proposed system should adapt to the existing local conditions. And the existing infrastructure and system should be availed as much as possible.
OMR	(OMR cost and manpower) In order to secure sustainability, OMR cost and manpower input should be within the amount that is affordable for the government.
Durability	(natural circumstance) The proposed system should be available in a critical circumstance.
Economic aspect	(cost and space) Disaster prevention reduces damage value but does not produce any positive economic value and lesser cost and space are preferable.

2) Evacuation System

The residents of the Study Area are usually threatened by the following hazards: pyroclastic flow, lava flow and ash fall (due to eruption of the Mayon Volcano), flood, inundation and mud and debris flow (caused by heavy rainfall) and strong wind (due to typhoon). Hence, the Study Team has identified evacuation-oriented coping strategy as one of the possible countermeasures, which will enable the affected residents to better cope with the effects of such hazards.

The strategy will involve designing evacuation centers that will consider the type of hazard that will affect the community and will ensure the safety and comfort of the evacuees during their stay there. It will also entail strengthening

of the present evacuation system that will be carried out based on a clear and detailed understanding of the disaster threat particularly on the part of the residents. In this case, public awareness campaign will also be given prime importance in this coping strategy.

(5) Resettlement Plan

In implementing the resettlement plan, the following should be taken into due consideration:

a. Avoidance of enforced relocation, even though its program turned out to be feasible,

b. Minimization of relocation by exploring all viable options in case that it becomes unavoidable,

c. Respect and conservation to the greatest extent possible of the existing social and cultural institutions and communities of the resettlers, and

d. Preparation of the detailed inventory of the affected people during social preparation period prior to the project implementation.

There are two types of relocation/ resettlement to be considered in this Study. One is related to the resettlement of the people living within a 6km radius from the crater of Mayon Volcano. The other concerns the “relocation” caused by implementation of the disaster prevention projects or due to acquisition of the right-of-the way and construction of the disaster prevention facilities.

The number of the people to be resettled from the 6km-radius zone is estimated to be 440 households or 2,332 residents, while that to be relocated due to implementation of the mud and debris flow project works may amount to 137 households or 726 residents.

The principles for resettlement planning in the Study Area are as follows:

1) The resettlement site must be located in a safer place in terms of the land use and environmental regulations and restrictions.

2) The eligible people to be displaced should be compensated and assisted in restoring and improving their living standard.

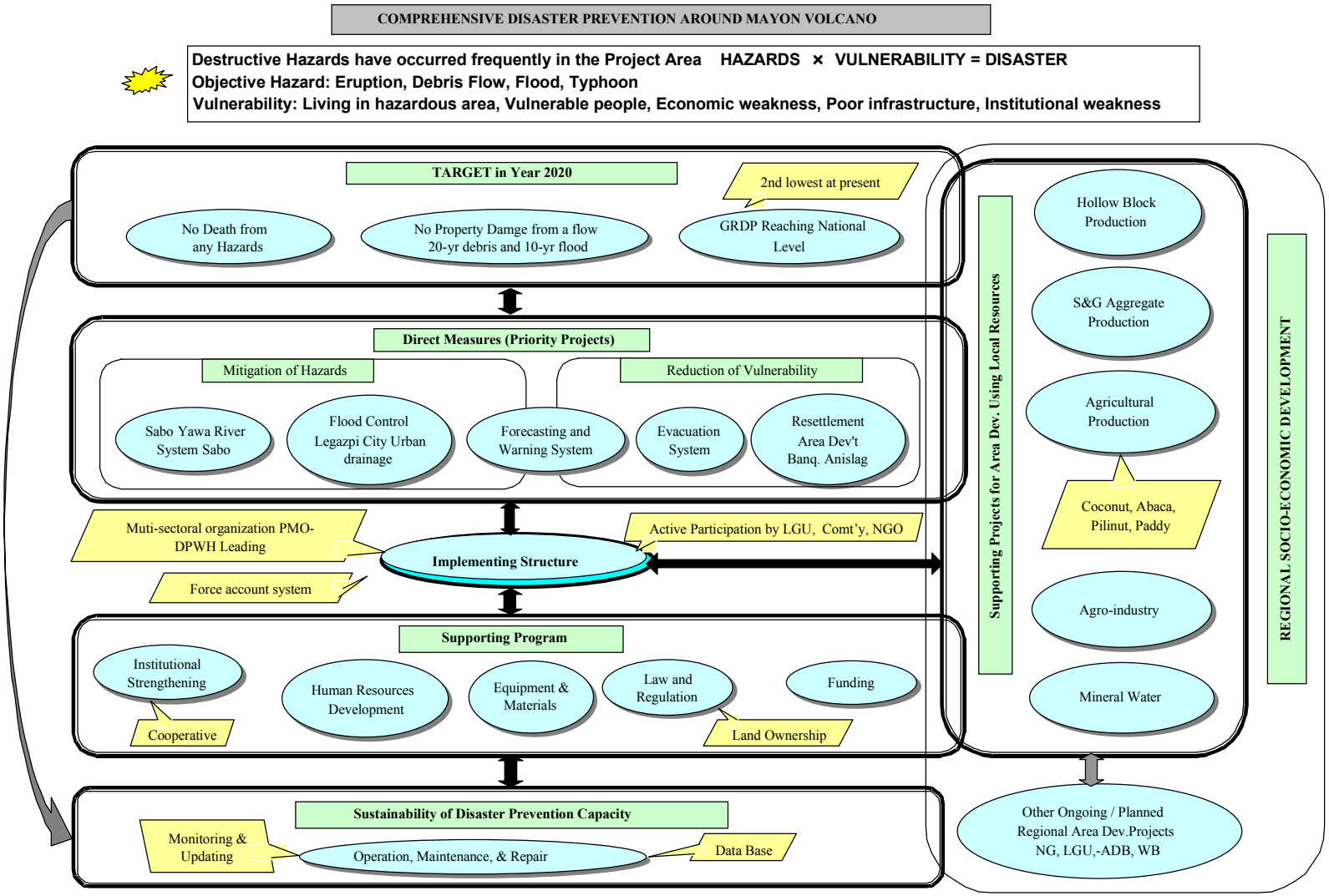
3) The housing plan has to be designed to allow for the gradual expansion or improvement in the structure according to the needs, preferences, and capacity of the families.
4) In principle, resettlement of the people is to be done within the respective administrative divisions (municipality and city).
5) The resettlement site should be equipped with the following facilities to form an integrated community: housing area, electricity, drainage, water supply system, access roads, sewerage system, elementary school, day care center, chapel, etc.
6) Design standards proposed in the Master Plan Study
   - Lot allocation: 120 m^2 (10 m x 12 m)
   - House lot: 21.7 m^2
   - Strength of the house: withstanding 200km per hour wind velocity, earthquake of moderate intensity (6 Richter scale), and other similar natural hazards
   - Materials/components and maintenance of the house and site: The core house will be awarded, but its maintenance will be done by residents themselves. The gradual improvement is allowed according to the needs, preferences, and capacity of the families.
   - Implementation of social infrastructure and livelihood development programs as an integral part of the resettlement project

4.4 Basic 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.

a. No deaths from any natural hazards like Mayon eruption, mud and debris flow, typhoon and flood,
b. No damages to the properties from the hazards of a 20-year probable mud and debris flow and 10-year probable flood, and
c. GRDP in the Study Area to reach to the national average level in 2020**.**

The targets of the Comprehensive Disaster Prevention and its framework are illustrated in Figure S.1.



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

JAPAN INTERNATIONAL COOPERATION AGENCY

Figure S.1

Targets of the Comprehensive Disaster Prevention and Its Framework

4.5 Land Use Plan

(1) Basic Concept

The two major aims are conceived for land use plan.

- Prevention of Area Decrease for Agriculture
- Improvement of the Productivity

For these aims, the development plans of Sabo, Agriculture, and Livelihood have been proposed.

Based on this, the land use plan has been proposed with the consideration points as follows.

- Hazard Zone : lava and pyroclastic flow, mud and debris flow, flood
- Environmental Category: NIPAS (Mayon Volcano National Park), Non-NIPAS, SEA
- Agricultural Category : Food Security, NPAAD, Agrarian Reform

(2) Land Use Plan

Three alternatives had been proposed as the possible plan. These alternatives can be assessed under the economic evaluation to be chosen as the final plan.

- Alternative I : Without Sabo Project + Resettlement of All Residents.
- Alternative II : Sabo Project + Intensive Agricultural Plan + Resettlement Plan

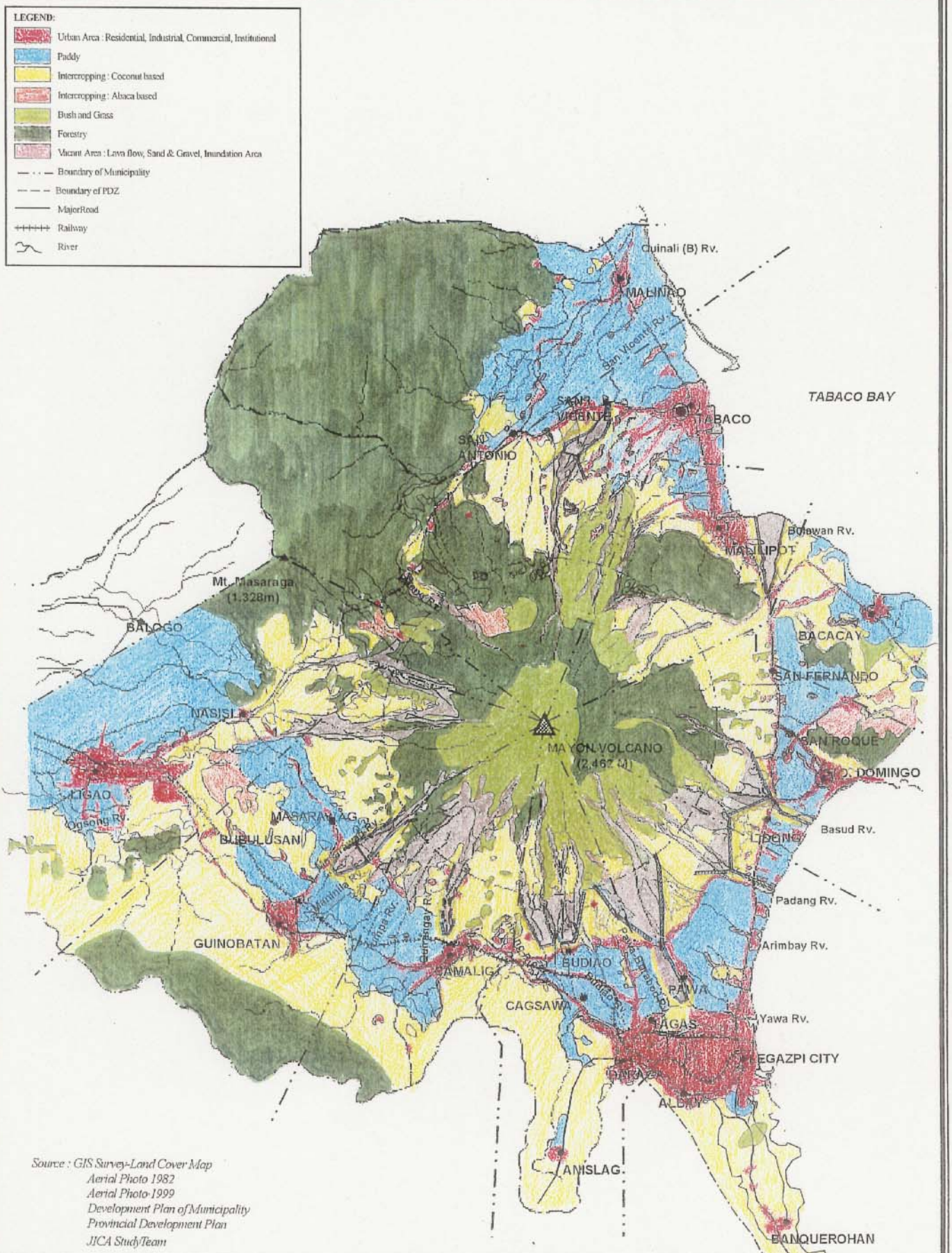
  Enhancement of the productivity keeping the present land use.
- Alternative III : Sabo Project + Agricultural Plan + Agro-industrial Plan + Resettlement Plan

  Enhancement of the productivity by the intensification of the land use.

As to the land use in 2020, refer to Figure S.2.

4.6 Regional Socioeconomic Development Plan

Through promotion of regional or area economic development, “economic surplus” is expected which may enable the local governments and communities to keep aside a certain fund for disaster management. This area economic development is also necessary to realize the per capita GRDP of the Study Area set in the socioeconomic framework of the Master Plan.


LEGEND:
Urban Area : Residential, Industrial, Commercial, Institutional
Paddy
Intercropping : Coconut based
Intercropping : Abaca based
Bush and Grass
Forestry
Vacant Area : Lava flow, Sand & Gravel, Inundation Area
Boundary of Municipality
Boundary of PDZ
MajorRoad
Railway
River
Quinali (B) Rv.
MALINAO
San Vicente Rv.
SAN VICENTE
TABACO
TABACO BAY
SAN ANTONIO
Bonawan Rv.
MALILIPOT
Mt. Masaraga (1,328m)
BALOGO
BACACAY
SAN FERNANDO
NASISI
MAYON VOLCANO (2,462 M)
SAN ROQUE
STO. DOMINGO
LIGAO
Ogsong Rv.
MASARAGA Rv.
BUBULUSAN
LIDONG
Basud Rv.
Padang Rv.
GUINOBATAN
Arimbay Rv.
BUDIAO
AMALIG
PAWA
CAGSAWA
Yawa Rv.
LEGAZPI CITY
DARAGA
ALBAY
ANISLAG
BANQUEROHAN
Source : GIS Survey-Land Cover Map
Aerial Photo 1982
Aerial Photo 1999
Development Plan of Municipality
Provincial Development Plan
JICA StudyTeam
COMPREHENSIVE DISASTER PREVENTION AROUND MAYON VOLCANO IN THE REPUBLIC OF THE PHILIPPINES
JAPAN INTERNATIONAL COPERATION AGENCY
Figure S.2 Land Use in 2020
0
5000m
N

The point of contact between "disaster prevention" and "area development" would be the "livelihood projects" to be implemented in the resettlement sites. These livelihood projects and programs proposed coupled with the resettlement sites development is expected to form local development growth centers. The area development projects and programs formulated in the Provincial and City/ Municipal Development Plans are necessary to sustain and promote these livelihood projects, and will play a leading role.

The following are the major area development projects, which are expected to be materialized in the near future:

- Legazpi City Special Economic Zone (Phase I : 33ha),
- Bicol Regional Agro-industrial Center (BRAIC),
- International Airport Construction Project at Bariis (Legazpi City),
- Improvement of Legazpi Port,
- Improvement of Tabaco Port,
- Rehabilitation of the Philippine National Railways,
- Improvement & Construction of Roads in Urban Centers and Tourism Areas,
- Construction of Pantao Port, and
- Others.

All of these area development projects should be implemented in parallel with or incorporating the disaster prevention works so as to generate the expected project efficiency and effectiveness.

4.7 Institutional Improvement Plan

Community-based approach in disaster management stipulated by PD1566 encouraged the active involvement of LGUs and the people in disaster management. Though the community-based approach in disaster management that has been advocated in the Philippines, there are some institutional constraints to disaster prevention in Mayon Volcano areas. The institutional improvement plan in community-based disaster management is summarized below, by categorizing them into the following three aspects: regulatory, operational, and financial aspects.

1) Regulatory Improvement Plan

- Revision of National Calamities and Disaster Preparedness Plan – priority over maintenance of existing facilities over newly proposed facilities

- Monitoring Responsibility for Mud and Debris Flow – DPWH has technical capacity. DPWH should be responsible for Mud and Debris Flow Monitoring

2) Operational Improvement Plan

- Review of the Government Policy on Budget Allocation
- Inter-LGU Cooperation Agreement on Disaster Management should be recommended
- Non-Structural Mitigation Measures as national building code and land use plan at Provincial and Municipal Levels should be prepared
- Review of Disaster Preparedness Plan and Contingency Plan (Operation Manual) prepared at Municipal and Barangay levels
- Integration of Public Education Campaign on disaster and its precautionary measures in school curricula

It is necessary to increase the "economic surplus" by promoting the economic development in order to implement these improvement plans. For generation of such surplus, the increase in productivity is required. Besides, the public education on disaster including its awareness raising and networking of inter-LGU cooperation activities in disaster coping would be indispensable to strengthen the disaster management.

4.8 Sabo Planning

(1) Selected Project

Candidate Sabo projects in this Study Area are selected by the conditions and criteria for this Study as follows.

1) Yawa River System Sabo Project (SF-1)
2) Quinali (A) River System Sabo Project (SF-2)
3) Buang River Sabo Project (SF-3)
4) San Vicente Sabo Project (SF-4)
5) Padang River Sabo Project (SF-5)
6) Basud River Sabo Project (SF-6)
7) Bulawan River Sabo Project (SF-7)

(2) Proposed Alternative Plan

The Sabo facility treats the mud and debris flow, including the sediment run off by an eruption. To assume its extent, the probable runoff volume formula as the estimation model "Technical Standard for the Measures against Debris Flow (Draft), 1988, Ministry of Construction" was used as an estimation model of debris flow runoff volume. In this alternative study, the collapse of the volcano edifice is not assumed.

The quantitative relationship between the rainfall and the magnitude of mud and debris flow is not available. Therefore, no measurement of mud and debris flow was conducted in the Study. The empirical, the probable runoff volume formula as the estimation model "Technical Standard for the Measures against Debris Flow (Draft), 1988, Ministry of Construction" is applicable to estimate the magnitude of mud and debris flow on the basis of a rainfall depth. The formula reflects the topographic and geologic conditions of the site and has yielded satisfactory results in Japan.

(3) Facility Alignment

The basic components of each alternative plan for Sabo planning are as follows:

1) Sand Pocket (Sabo dam + Long spur dike)

The proposed sand pocket alignment is composes of long spur dikes and the Sabo dam. This alignment is designed to trap sediment material, and to protect houses and cultivate area widely.

2) Spur Dike and Training Dike

The proposed spur dike and the training dike converge debris flows into one channel, and the debris flows out downstream safely and directly.

3) Protection Dike

The proposed protection dike is designed to protect only houses as protected objects. Debris flow is dispersed for two direction by protection dike which has alignment of wedge type.

4) Facility design for Sabo Planning

The proposed facilities in the Study Area will be designed with the following structural conditions:

- Strong and large-scale facilities constructed in the past exist along Pawa-Burabod river, Budiao river, Quirangay river, Masarawag river, and Nasisi river.
- Part of the facilities around Mayon volcano will need rehabilitation.
- In facility design for structural planning, CSG (concrete, sand and gravel) method will be widely adopted to minimise the cost.
- CSG method was a kind of aggregate as the filling material for created embankment of spur dikes and consolidation. Sabo works in Pinatubo have already used it in the Philippines and have shown its advantage.
- Advantage of CSG method is easy construction work, low cost and high local supplement.

4.9 Flood Control Facility Strengthening

(1) River Improvement Plan

1) Candidate Scheme

Several candidate schemes for river improvement in the Study Area are selected by the conditions and criteria for the Study as follows.

a. Yawa river improvement project
b. San Vicente river flood way project
c. Quinali (B) river improvement project
d. Nasisi river improvement project
e. Ogsong river improvement project

Rivers other than the above selected rivers will be treated by Sabo works and no river improvement works are recommended by the Study.

Backwater effects occasionally occur in the lowest reaches of the Quirangay, Tumpa, Maninila, and Masarawag rivers near the confluence to the Quinali (A) river. The river improvement for the Quinali (A) river is a premise for solving the inundation in the lowest reaches of those rivers affected by the backwater from the Quinali (B) river. The lowest parts of those rivers are situated south of National Highway passing between Legazpi and Ligao.

2) Basic Concept and Alternative Plan

a. Basic Concept

Basic concepts for river improvement plan are:

- to mitigate flood damage in the flood prone area
- to upgrade the function of river as a flood way for Sabo works
- to enhance the productivity of land use

b. Alternative Plan

Based on the basic concepts, several alternative plans are considered as follows.

i. Dredging the river channel
ii. Raising the existing dike
iii. Widening the river channel with embankment
iv. New flood way

Alternative iii. is selected for all schemes to secure in advance the right of way for future river improvement works suitable for a 100-yr probable flood.
Alternative iv. is selected for the San Vicente river to mitigate the flood inundation in Malinao by diverting the river course into the sea instead of presently draining into the Quinali (B) river.

(2) Urban Drainage Plan

1) Conceivable Countermeasures

a. Increase of Flow Capacity

The main river channels such as the Macabalo and Tibu rivers are to be enlarged if design discharge is larger than flow capacity of the existing channels. But, to minimize the social impact of land acquisition along the main river channels, it is fully recommended to maintain the existing river width as much as possible. The flow capacity of two rivers is estimated to be around a 5-year probable flood peak discharge. Riprapping of the channels is properly installed along the water course.

b. Pump Drainage

Pumping Stations

Pump drainage system is highly recommended to minimize the flood damage in the city. Suitable size of pumping station is to be determined to minimize the project cost.

c. Flood Gates

Suitable size of flood gate is to be installed in the Macabalo and Tibu rivers to protect the low-lying areas from the intrusion of tidal flood in the City.

d. Retention pond

Installation of retention pond is considered as an effective measure to regulate flood peak and to minimize the size of pumping station if installed with a pumping station.

2) Proposed Drainage Plan

The proposed drainage plan is selected as an integration of all conceivable alternative plans considered as follows.

a. Riprapping along main river channels (Macabalo and Tibu rivers)
b. Flood gates to protect tidal flood into the rivers
c. Pumping stations to compulsorily drain interior flood inundation with flood gate operation
d. Retention pond to regulate flood peak

4.10 Forecasting, Warning and Evacuation

(1) Forecasting and Warning System

The prevailing forecasting and warning system adopted by the PAGASA is the only conceivable system with regard to a typhoon. Several candidate systems are conceivable to forecast a volcanic eruption, mud and debris flow and flood and inundation and to disseminate warning as follows:

1) For Eruption

a. Monitoring of the Activity of Magma
   - Seismic sensor of three elements, good for the period of 20 seconds with telemeter
   - Analyzing and data storing processor with A/D converter
   - Graphic terminal with DAT or MO control function

b. Monitoring of Deformation of the Mountain
   - GPS with a simulation model to assess the pressure of magma on the basis of the deformation

c. Monitoring of SO_2
   - Automatic gas sampler with simple analyzer and telemeter system
   - Automatic wind velocity and direction recorder with telemeter system

2) For Mud and Debris Flow
   - Optical sensor
   - Seismic sensor

- Supersonic water level gauge
- Acoustic sensor
- Event reporting type rainfall gauge
- Telemetering system is fundamental to all

3) For Flood and Inundation
- Telemetered rainfall gauging system
- Telemetered water level gauging system
  - ・ Float type
  - ・ Supersonic type water level gauge and velocity meter

(2) Warning System

1) For Warning System
- Inter-agency disaster information network with client server
- Inter-agency disaster information network with web server
- VHF radio communication system
- Radio paging system and equipment for barangay

(3) Evacuation System

1) Evacuation Center
- Location of centers : Existing school buildings
- Installation : Extension of existing centers
- Facilities : Water supply, toilet and consumables

2) Livestock Sanctuary
- Number : One for each municipality
- Accommodation : Cattle, pig, and poultry

3) Emergency shelter
- Objective : Protection of the people working in the PDZ
- Location : Plantation along footpath

4.11 Resettlement Sites Development

The existing and planned resettlement sites are respectively located at the following places:

Existing Sites : Baligang (Ligao), Banquerohan[1](Legazpi), Batawon (Camalig), Buang (Tabaco), Quitago (Guinobatan), and Mi-isi (Daraga)

[1] Banquerohan resettlement project has an expansion plan (Phase II: 27ha).

Planned Sites : Anislag (Daraga), San Andres (Sto.Domingo), San Vicente (Tabaco), and Sta. Teresa & San Isidro (Malilipot).

For the existing resettlement sites, it is advised to review their present conditions and carry out the improvement and/or expansion works referring to the "design standards" proposed in the Master Plan. In addition to the above site improvement and/or expansion, livelihood projects/programs are to be implemented as a package for sustainable development of the respective resettlement communities. The key factors to select the livelihood programs include: (a) labour-intensive or employment generation, (b) utilization of local resources (materials & expertise), (c) prospects of marketability, and (d) availability of the utilities (water and energy).

The livelihood development and supporting services strengthening projects/ programs are to be composed of multi-sectoral components such as: (a) on-farm or marine development, (b) industrial and manufacturing development, (c) tourism promotion and (d) institutional and system strengthening. To ensure the sustainability of the proposed projects and programs, it is essential to formulate an integrated supporting program, including institutional and financial arrangements.

4.12 Supporting Programs for Comprehensive Disaster Prevention

The supporting programs with some typical components are indicated below for realization of the comprehensive disaster prevention.

(1) Programs at Central (or National) Level

Strengthening of the National Disaster Management System

- Review of institutional and organizational set-up,
- Consolidation of financial system (focusing on budget allocation & appropriation),
- Capability building of the management office staff in NDCC, and
- Others.

(2) Programs and Projects at Provincial Level

Strengthening of the Provincial Disaster Management System

- Policy and legal arrangements to cope with the current disaster-related issues such as optimum land use, enforcement of laws & regulations, and ownership.

- Capacity building of PDCC /PDMO, and
- Others

(3) Programs and Projects at Community (City/Municipality) Level

Community‐based Disaster Management Strengthening

- Institutional Consolidation of CDCC/MDCCs including BDCCs and capability building of their disaster management staff,
- Resettlement community development program in association with livelihood programs and projects), and
- Others.

Area Development and Livelihood Supporting Projects & Programs

- Development of mini-industrial estates,
- Key agribusiness commodities and high value added product development,
- Micro-lending development,
- Livelihood cooperative strengthening program (livelihood plaza & handicraft center),
- Exploitation of construction materials like sand and gravel,
- O&M business development owing to expanded/intensified use of the construction equipment for Sabo works, trading facilities, etc., and
- Others.

CHAPTER 5 MASTER PLAN

5.1 Basic Conditions for Master Planning

(1) Basis for Planning

The Master Plan was formulated in referring to the following plans and programs: (a) land use plan, (b) disaster prevention plans and programs and (c) supporting programs. The proposed disaster prevention plans were discussed and assessed on the basis of the assumed land use. In addition, the supporting programs are proposed to complement and assist the sound implementation of the proposed disaster prevention plans.

(2) Preliminary Screening of the Candidate Projects

To screen out the proposed coping projects, an economic and social assessment was preliminarily carried out.

1) Sabo Works

a. Economic Viability

Economic evaluation was carried out for Yawa River System to select the target scale of planning in terms of return period (10-, 20- and 5-year) and land use plans for three options (Option 1 to 3). As a result, the return period of 20-year and land use plan of Option 3 yielded the highest EIRR. Then the other six river systems and rivers were economically evaluated for return period of 20-year and land use plan of Option 3. The result of evaluation is summarized as follows:

River Systems or Rivers	EIRR (%)	B/C
1. Yawa	24.67	1.58
2. Quinali (A) - Alternative A	16.32	1.07
3. Buang	21.67	1.43
4. San Vicente	18.49	1.21
5. Padang	19.14	1.28
6. Basud	14.00	0.95
7. Bulawan	17.16	1.16

b. Social Assessment

The following table presents the numbers of beneficiaries and the people to be affected to demonstrate the social impact of each project.

River Systems or Rivers	No. of Beneficiaries	No. of Relocated
1. Yawa	758	65
2. Quinali (A)	1,619	21
3. Buang	16	5
4. San Vicente	129	8
5. Padang	574	38
6. Basud	134	0
7. Bulawan	467	0

2) Flood Control and Urban Drainage

a. Economic Viability

The EIRRs were estimated for the rivers of Yawa, Quinali (B), San Vicente, Nasisi, Ogsong, and Legazpi City as summarized below. The Legazpi City Urban Drainage Project is economically viable but other projects are not viable according to their EIRRs.

River Systems or Rivers	Return Period (Year)	EIRR (%)
1. Yawa	20	10.08
2. Quinali (B)	20	5.66
3. San Vicente	20	6.47
4. Nasisi	20	5.23
5. Ogsong	20	6.10
6. Legazpi Drainage	10	23.96

b. Social Assessment

Social assessment was done by estimating the number of beneficiaries. Legazpi drainage project is estimated to bring about 1,663 beneficiaries, as shown below:

River Systems or Rivers	No. of Beneficiaries
1. Yawa	391
2. Quinali (B)	488
3. San Vicente	331
4. Nasisi	50
5. Ogsong	402
6. Legazpi Drainage	1,663

5.2 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.

Direct Coping Projects

(1) Sabo Facility Construction

SF-1 : Yawa River System Sabo Project		
1.	Objective	All debris materials must be trapped in the proposed sand pocket. The proposed plan for Yawa river system keeps an extensive land for enhanced land use.
2.	Components	- Site : Anoling River and Pawa-Burabod River - Sabo Facility: Sand pocket to deposit debris flow materials - Probable 1-day rain fall with the return period of 20 years - Estimated Annual Runoff Volume : 808,000m^3/year - Storage Capacity: 28,400,000m^3 - Protected Area and Property: 26,585,500m^2 in Legazpi City area, Yawa main river, railways, Cagsawa ruins, national road, etc. - O&M Work: 23,600m^3/year
3.	Work Volume	- Sabo Dam (C.S.G.): Length = 1,100m, Height = 4.0m (Anoling River: 600m, Pawa-Burabod: 500m) - Spur Dike: ・ C.S.G.(Type-A): Length = 1,900m, Height = 5.0m (Anoling River: 1,900m) ・ Combined (Type-B): Length = 5,100m, Height = 5.0m (Anoling River: 1,730m, Pawa-Burabod River: 3,370m) ・ Embankment (Type-C): Length = 600m, Height = 5.0m (Pawa-Burabod River: 600m) - Training Dike: Length = 5,100m, Height = 2.3m (Anoling River: 4,750m, Pawa-Burabod River: 350m)
4.	Project Cost	- PHP2,344.5 million
5.	Economic Evaluation	- EIRR: 24.67% - B/C: 1.58

SF-2 : Quinali (A) System Sabo Project		
1.	Objective	Debris flow materials are to be gathered into main channel by spur dike and flowed down between barangays and the paddy field safely. This project aims to keep an extensive land for enhanced land use.
2.	Components	- Site : Masarawag River and Quirangay River - Sabo Facility: Sand pocket with a ground sill to be used for dispersing and depositing the debris flow. Guiding dike or spur dike to meet the Maninila river flow with the Masarawag river flow artificially. - Probable 1 day rainfall with a return period of 20 years - Estimated Annual Runoff Volume : 510,000m^3/year - Storage Capacity: 6,262,000m^3 - Protection Area and Property: 14,000,000m^2 including Barangays, railways, national road, paddy field, etc. - O&M Work: 318,400m^3/year

SF-2 : Quinali (A) System Sabo Project		
3.	Work Volume	- Sabo Dam (CSG): Length = 450m, Height = 4.0m (Masarawag River: 100m, Quirangay River: 350m) - Spur Dike: ・ C.S.G.(Type-A): Length = 2,200m, Height = 5.0m (Masarawag River: 1,250m, Quirangay River: 950m) ・ Combined (Type-B): Length = 2,750m, Height = 5.0m (Masarawag River: 2,050m, Quirangay River: 700m) ・ Embankment (Type-C): Length = 1,050m, Height = 5.0m (Masarawag River: 1,050m) ・ Ground Sill (Type-D): Length = 900m, Height = 1.5m (Masarawag River: 900m) ・ Raising Dike (Type-E): Length = 1,700m, Height = 2.0m (Quirangay River: 1,700m) - Training Dike: Length = 3,050m, Height = 2.3m (Masarawag River: 2,100m, Quirangay River: 950m)
4.	Project Cost	- PHP1,912.8 million
5.	Economic Evaluation	- EIRR: 16.32% - B/C: 1.07

SF-3 : Buang River Sabo Project		
1.	Objective	Only the property of Barangay along the Buang River is to be protected by the protection dike. The Buang River has the natural retarding basin at its downstream reach before it joins to the Quinali (B) river.
2.	Components	- Site : Buang River - Sabo Facility: Protection dike to protect the spot area - Probable 1 day rainfall with a return period of 20 years - Estimated Annual Runoff Volume : 539,000m^3/year - Protection Area and Property: 1,187,000m^2 including Barangays, national road, etc. - O&M Work: Not required
3.	Work Volume	- Spur Dike: Combined (Type-B): Length = 1,150m, Height = 5.0m
4.	Project. Cost	- PHP249.1 million
5.	Economic Evaluation	- EIRR: 21.67% - B/C: 1.43

SF-4 : San Vicente Sabo Project		
1.	Objective	Debris flow materials should be gathered into main channel and flowed down between barangays and the paddy field safely. This project aims to confine an avulsion of debris flow.
2.	Components	- Site : San Vicente River - Sabo Facility: Sand pocket - Probable 1 day rainfall with a return period of 20 years - Estimated Annual Runoff Volume : 306,000m^3/year - Storage Capacity:12,015,200m^3 - Protection Area and Property: 10,364,000m^2 including Barangay (San Vicente), national road, paddy field, river improvement in the plain area, etc. - O&M Work: 16,200m^3/year
3.	Work Volume	- Sabo Dam (C.S.G.): Length = 600m, Height = 4.0m - Spur Dike: ・ CSG (Type-A): Length = 2,400m, Height = 5.0m ・ Combined (Type-B): Length = 2,700m, Height = 5.0m
4.	Project Cost	- PHP1,459.4 million
5.	Economic Evaluation	- EIRR: 18.49% - B/C: 1.21

SF-5 : Padang River Sabo Project		
1.	Objective	There are some tributaries next to the target rivers. Debris materials should be converged into one channel and trapped by the structure measure. This project is designed to trap the sediment materials at the upstream reach area from the national road.
2.	Components	- Site : Padang River and Golf course channel - Sabo Facility: Sand pocket - Probable 1 day rainfall with a return period of 20 years - Estimated Annual Runoff Volume : 211,000m^3/year - Storage Capacity:13,500,000m^3 - Protection Area and Property: 8,358,800m^2 including Barangay, national road, etc. - O&M Work: 5,300m^3/year
3.	Work Volume	- Sabo Dam (CSG): Length = 350m, Height = 4.0m - Spur Dike: ・ C.S.G.(Type-A): Length = 3,950m, Height = 5.0m ・ Combined (Type-B): Length = 600m, Height = 5.0m
4.	Project Cost	- PHP960.4 million
5.	Economic Evaluation	- EIRR:19.14% - B/C: 1.28

SF-6 : Basud River Sabo Project		
1.	Objective	There are some tributaries next to the target rivers. Debris materials are to be converged into one channel and trapped in the proposed sand pocket. This project is designed to trap the sediment materials at the upstream reach area from the national road.
2.	Components	- Site : Basud River and one parallel channel - Sabo Facility: Sand pocket - Probable 1 day rainfall with a return period of 20 years - Estimated Annual Runoff Volume : 198,000m^3/year - Storage Capacity:17,100,000m^3 - Protection Area and Property: 6,480,000m^2 including Barangay, national road, etc. - O&M Work: 4,300m^3/year
3.	Work Volume	- Sabo Dam (CSG): Length = 350m, Height = 4.0m - Spur Dike: ・ CSG (Type-A): Length = 2,500m, Height = 5.0m ・ Combined (Type-B): Length = 500m, Height = 5.0m
4.	Project Cost	- PHP584.9 million
5.	Economic Evaluation	- EIRR: 14.00% - B/C: 0.95

SF-7 : Bulawan River Sabo Project		
1.	Objective	On the upstream area, it is possible that one tributary of the Bulawan River will capture the Tabigyan River. Facility planning should protect this piracy phenomenon. This project is able to protect such a channel movement by reasonable planning.
2.	Components	- Site : Bulawan River - Sabo Facility: Continuous spur dike to guide the debris flow to the downstream reach. Deflection dike to protect the piracy. - Probable 1 day rainfall with a return period of 20 years - Estimated Annual Runoff Volume : 445,000m^3/year - Protection Area and Property: 3,739,300m^2 including Malilipot town proper, national road, bridge, etc. - O&M Work: not required
3.	Work Volume	- Spur Dike: ・ Combined (Type-B): Length = 1,350m, Height = 5.0m ・ Combined (Type-C): Length = 3,050m, Height = 5.0m
4.	Project Cost	- PHP769.2 million
5.	Economic Evaluation	- EIRR: 17.16% - B/C: 1.16

The Sabo Master Plan projects for each river are summarized below:

The Master Plan Projects for Sabo Facility Construction

River System	River	Type	Work Volume (Length)			Run Off Volume (1,000 m^3)	Pocket Capacity (1,000 m^3)	Direct Cost (PHP Million)	EIRR (%)
			Sabo Dam (m)	Spur Dike (m)	Training Dike (m)				
Yawa River System	Yawa	River Improvement	-	-	-	-	-	-	-
	Pawa-Burabod	Sand Pocket	500	3,970	350	209	5,280	2,344.5	24.67
	Budiao	Sand Pocket	-	-	-	107	23,120		
	Anoling	Sand Pocket	600	3,630	4,750	492			
Quinali (A) River System	Quirangay	Sand Pocket	350	4,300	950	156	1,830	1,912.8	16.32
	Tumpa	No Action	-	-	-	-	-		
	Maninila	Spur Dike		450	-	168	4,432		
	Masarawag	Sand Pocket	100	6,500	2,100	186			
	Ogsong	No Action	-	-	-	-	-	-	-
	Nasisi	No Action	-	-	-	-	-	-	-
Quinali (B) River System	Buang	Protection Dike	0	1,150		539	2,430	249.1	21.67
	Quinali(B)	River Improvement	-	-	-	-	-	-	-
	San Vicente	Sand Pocket	600	5,100		306	12,015	1,459.4	18.49
Arimbay River System	Arimbay	No Action	-	-	-	-	-	-	-
Padang River System	Padang	Sand Pocket	350	4,550	-	211	13,500	960.4	19.14
Basud River System	Basud	Sand Pocket	350	3,000	-	198	17,100	584.9	14.00
Bulawan River System	Bulawan	Spur Dikes and Deflection Dike	0	4,900	-	445	6,840	769.2	17.16
Total		-	2,850	37,550	8,150	3,017	86,547	8,280.3	-

(2) River Improvement

Alternative iii (widening the river channel with embankment) is selected for the Yawa River Improvement Project.

RI-1 : Yawa River Improvement Project		
1.	Objective	The project aims to mitigate flood damage in the flood prone area and upgrade the function of the river as a suitable flood way for Sabo works in the upper tributaries and enhance the productivity of land use along the river improvement portion.
2.	Components	- Length of Dike: 2,000m from the river mouth - Design Discharge: 1,350m^3/s (20 years) - Design Depth: 4.4m - Design River Width: 90m - Design River Cross Section: Double trapezoid
3.	Work Volume	- Embankment: 203,000m^3 - Excavation: 85,000m^3 - Wet masonry: 20,000m^2
4.	Project Cost	- PHP509.2 million
5.	Economic Evaluation	- EIRR: 10.08% - B/C: 0.65

(3) Urban Drainage

The proposed drainage plan in Legazpi City is selected as an integraton of all alternative plans considered for Macabalo and Tibu rivers as follows.

- Rip-rapping along main river channels
- Flood gates to protect tidal flood into the rivers
- Pump drainage to drain flood water to the sea
- Retention pond to regulate flood peak

UD-1 : Legazpi City Urban Drainage Project		
1.	Objective	The project aims to mitigate flood inundation in the Legazpi City that situates in low-lying area frequently caused by interior flood and tidal flood.
2.	Components	- River Improvement: 1,700m for Macabalo & 34m for Tibu - Pumping Facility (2 stations): 10m^3/s for Macabalo & 1m^3/s for Tibu - Flood Gate Facility (2 rivers): 5 gates for Macabalo & 3 gates for Tibu - Retention Pond (2rivers): 12ha for Macabalo & 0.5ha for Tibu
3.	Work Volume	- Channel Excavation: 36,400m^3 (Macabalo) & 1,500m^3 (Tibu) - Embankment: 4,840m^3 (Macabalo) & 437m^3 (Tibu) - Rivetment works: 2,534m^3 - Pumping Facility: 10 and 1m^3/s - Flood Gates: 5 units (3 x 3) for Macabalo & 3 units (3 x 3) for Tibu
4.	Project Cost	- PHP643.7 million
5.	Economic Evaluation	- EIRR: 23.96% - B/C: 1.73

(4) Forecasting, Warning and Evacuation

FW-1 : Forecasting, Warning and Evacuation System Strengthening Project		
1.	Objective	The project is designed to protect the life and property from the disaster to be caused by the volcanic eruption, flood, inundation, mud and debris flow and typhoon through evacuation to safer place prior to the occurrence of the hazard.
2.	Components	1) Forecasting - Seismographic telemeter system with 7 gauging stations (4 existing) - Slope deformation monitoring system with GPS - Slope deformation monitoring system with EDM (Existing) - $S0^2$ gas sampling and analyzing equipment (Existing) - Event reporting type rainfall gauging telemeter system with 41 gauging stations (5 existing) - Water level gauging telemeter system with 7 gauging stations - Typhoon monitoring system (Existing) 2) Warning - VHF radio system among agencies (Existing) - Inter-agency disaster information network with WEB servers - Radio paging system between CDCC/MDCCs and BDCCs 3) Evacuation (Improvement of Evacuation Center) - 114 evacuation centers for 1 City and 9 Municipalities with the area of 328,500m^2 (Existing area: 123,600m^2) - Water supply system with 855 faucets (Existing: 165 faucets) - 1,080 sets of toilets (Existing: 621 sets) (Emergency Shelter) - 16 sites of emergency shelter in 1 City and 9 Municipalities - 16 sets of tele-controlled siren systems in 1 City and 9 Municipalities (Livestock Sanctuary) - 10 sites of livestock sanctuaries in 1 City and 9 Municipalities
3.	Work Volume	- As described in the above components
4.	Project Cost	- PHP3,740.2 million

(5) Relocation and Resettlement

RR-1 : Relocation and Resettlement Projects		
1.	Objective	The project aims to improve the existing resettlement sites for the people already settled and develop the new resettlement sites for the people still residing within the permanent danger zone (6km-radius from the crater). It is also designed to accommodate those who will be relocated due to implementation of the physical projects around Mayon Volcano.
2.	Components	- Resettlement Development Sites: to be determined with the numbers of the households to be relocated/ resettled. ・ No. of residents within 6km-radius zone: 440 households (2,332 persons) ・ No. of the people to be relocated due to implementation of the Master Plan projects for Sabo and flood control facility construction works : 137 households (724 persons) - Plot Plan: 70% of the total resettlement site for housing lot area and 30% for communal facilities like main and access roads, town hall, plaza, school building, health center and others. - Facilities to be provided: houses (or core shelters), electricity, drainage, water supply system, access and circulation roads, sewerage system, elementary school, day care center, production area including "productivity center" adjacent to or near the resettlement site. - Standard House Area: 21.7m^2
3.	Work Volume	- Residential Development: 272 houses - Industrial Development: 16.1 ha
4.	Project Cost	- PHP186.6 million

(6) Institutional and Supporting Services Strengthening Projects and Programs

1) Central and Regional Level

NP-1 : National and Regional Disaster Management System Strengthening		
1.	Objective	This program aims to continue and extend the on-going strengthening efforts of the disaster management system at national and regional levels to upgrade/ support coordination activities among the disaster-related government agencies with respect to administrative and operational aspects that are essential for smooth implementation of comprehensive disaster prevention projects and programs.
2.	Components	- Establishment and strengthening of the overall coordination framework among the government agencies such as LGUs, DPWH, PHIVOLCS, OCD, DSWD, etc. as well as private sector and NGOs. - Creation of "Inter-Agency Task Force (IATF)" under NDCC/ RDCC to advise the NDCC/ RDCC on final decisions concerning coordination and arrangement with other departments, agencies and intra-departmental offices, and also on technical and administrative matters relating to implementation of the projects and programs. - Typical components of the Program: ・ Review of institutional set-up, ・ Consolidation of financial system (focusing on budget allocation & appropriation), ・ Capability building of the NDCC secretariat staff, ・ Promotion of the Flood Control and Sabo Engineering Center Project, ・ Operational guidance3 for international assistance and inter-area disaster coping agreement, ・ Establishment of a task force to study on incorporation of mitigation into specific development projects, and ・ Others.
3.	Project Cost	- PHP53.9 million

2) Provincial Level

PP-1 : Provincial Disaster Management System Strengthening		
1.	Objective	This program is designated with a view to upgrading managerial and operational capability of the Provincial Government staff in charge of disaster management (especially PDMO and PDCC), so that they can properly cope with disasters and take quick response actions in accordance with the Disaster Management Operation Manual.
2.	Components	- Capability building of the Provincial officers in charge of disaster management, especially those in the Provincial Disaster Management Office (PDMO) and other agencies concerned. - Programming and practice of the disaster management training taking into account the existing basis of competence of the target personnel. - Establishment of an information network system by installing a set of the facilities and equipment. - Upgrading of the disaster management information system to keep accuracy and reliability of the data and information on vulnerabilities to hazards, hazard areas and number of population residing in danger areas, etc. - Policy and legal arrangements to cope with the current disaster-related issues such as optimum land use, enforcement of laws & regulations, ownership, natural conservation and so on. - In this Program, the following will be taken up as the program components: ・ Capacity building of PDCC/ PDMO, ・ Consolidation of coordination framework and networking for disaster management (LGUs-DCCs-PDMO-NGAs-Private Sector/ NGOs), ・ Restructuring of the provincial system for integrating disaster mitigation into area development, ・ Reorientation of cooperation in disaster coping and conclusion of an agreement on response & recovery operations among the neighboring LGUs at every level, and ・ Others.
3.	Project Cost	- PHP2.2 million

PP-2 : Province-wide Socio-economic Development and Monitoring		
1.	Objective	To assure smooth implementation of the inter-city/ municipal projects/ programs and monitor the balanced socio-economic development of the province as a whole, this program also aims to strengthen a monitoring system by establishing a much closer linkage connecting the Provincial Government with its relevant city and municipalities.
2.	Components	- Establishment and strengthening of the overall coordination framework among the government agencies concerned such as the LGUs at every level, national government offices (both central and regional) as well as the private sector including NGOs. - This program will include the following typical projects and programs as indicated below: ・ Resettlement and livelihood development and monitoring, ・ Introduction and establishment of the "Social Investment Fund" as social safety net scheme to support/ assure the livelihood of disaster victims and social weak in the Province, ・ Establishment of Technology and Livelihood Development Center (TLRC) in Albay Province (TLRC data center & information technology support services for livelihood and entrepreneur development), ・ Eco-tourism development around Mayon Volcano (with one-stop eco-tourism guidance center and "Mayon eco-panorama promenade" under or in tie-up with disaster mitigation scheme), ・ Implementation of the socio-economic development projects and programs, centering on the increase in agricultural production, industrialization (agro-industry development in particular) and tourism, and ・ Others.
3.	Project Cost	- PHP5.6 million

3) Community or City/Municipality Level

CP-1 : Community-based Disaster Management Strengthening		
1.	Objective	This program is to extend the on-going efforts to upgrade/strengthen the disaster management system of the city/municipalities and barangays concerned in the Study Area.
2.	Components	- Capability building of the city/municipality and Barangay staffs in charge of disaster management, through execution of periodical staff training. - Programming and practice of the disaster management taking into account the existing basis of competence of the target personnel - Establishment of the information network system to assure communications among PDMO/PDCC, CDCC/MDCCs and BDCCs. - This program will incorporate the following disaster-related component programs: ・ Institutional strengthening of CDCC/MDCCs including BDCCs with capability building of their disaster management staff, ・ Enhancement of disaster coping capacity through upgrading of the forecasting & warning and evacuation system, ・ Resettlement community development program in association with livelihood programs and projects, ・ Strengthening of volunteer disaster operation groups, ・ Awareness promotion campaign and enlightenment on disaster management through seminars, workshops and drills for general public and including the disaster-related education at primary and junior schools, ・ Preparation of the comprehensive city/ municipal land use plan including hazard mapping & resource assessment, key commodity development strategy, etc. and ・ Others.
3.	Project Cost	- PHP11.3 million

CP-2 : Livelihood Development Projects and Programs		
1.	Objective	For sound operations of the resettlement project, especially for their sustainability, the livelihood programs and projects are to be carried out in parallel and as a package with institutional and financial supporting programs and even coupled with area socio-economic development projects. The livelihood development and supporting programs could be categorized into the following five components.
2.	Components	CP-2(1) On-farm and Marine Production Enhancement - Introduction and practice of a new scheme named "Farm Land Trust Management" under the auspices of LGU and other authorities concerned like DAR, DA, CDA, etc. - Production enhancement by inter-cropping farming (mostly coco-based one with banana, pili, abaca, corn, etc.) with a view to assuring a stable livelihood of thenant farmers. - Production of quality raw materials to provide stably the agro-based industries to be set up within or nearby the resettlement sites. CP-2(2) Agro-industry and Manufacturing Development - Creation of job opportunities for the resettlers to enable them to make a living without returning to the former farming places at risk and losing their means of livelihood for those affected by implementation of the structural projects.

CP-2 : Livelihood Development Projects and Programs		
		- Establishment of a "productivity center" or mini-industrial estate by installing the post-harvest, processing and/or manufacturing facilities and such equipment, together with the basic infrastructure development such as access road, utilities (water and power) and so on. CP-2(3) Tourism Promotion - Development of new tourist spots or resorts endowed with majestic scenery of the Mayon Volcano, and adopting and eco-tourism concept. - The eco-tourism development around Mayon Volcano with disaster preventive structures like access roads, dikes, groundsills, sand pockets and others (ex. Mayon eco-panorama promenade). - Establishment of several one-stop tourism guidance centers at major tourist spots (together with handicraft souvenir shops and stalls) to promote tourism in the area. CP-2(4) Institutional and Supporting System Strengthening - Institutional strengthening to insure the sustainability of the projects and programs proposed in the Master Plan, mainly focusing on the human resources development in the resettlement communities. - Provision of the various levels of training programs for capability buildings in the following areas of concerns: ・ For the resettled people: building cooperative partnership, micro-lending scheme, productivity enhancement, entrepreneurial and information systems management, etc. ・ For the staff in charge of disaster management: planning, crisis management activities, logistic functions, recovery management, etc. CP-2(5) Farm Land Trust Management - Intervention of the LGU as guarantor to assure its smooth implementation in close cooperation with the authorities concerned such as CDA, DAR, DA and PCA. - Establishment of a special taskforce unit in each LGU concerned to prepare an inventory of candidate trust farmlands and a list of potential participant farmers. - Grouping of participant farmers into cooperatives (coops) considering the respective farming activities and their crops, to ensure the sustainability of this trust management system. - Institutionalization and strengthening of the established coops to enable to manage and operate this trust management system, and even negotiate the terms of lease with the landlords. The coops are to be entrusted by member farmers to deal with transactions for financing, post-harvest & processing and marketing on behalf of member farmers.
3.	Project Cost	- PHP54.6 million

5.3 Cost Estimate

(1) Constitution of Project Cost

Project cost comprises: (a) construction cost, (b) government administration cost, (c) engineering services cost, (d) land acquisition cost, (e) physical contingency, and (f) price contingency.

(2) Basic Condition of Cost Estimate

1) Base year : July 1999
2) Exchange rates : US$ 1.0 = PHP 38.2 = ￥122.4
3) Price escalation : 7.85% per annum
4) Estimated on unit price basis

(3) Summary of Estimated Project Cost

Total project cost for structural countermeasure 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 13.49 billion.

(4) Operation and Maintenance Cost

The annual operation and maintenance cost is summarized below.

Operation and Maintenance Cost

(Unit: Million PHP)

Code No.	Description	Amount
Sabo Facility Construction		
SF-1	Yawa River System Sabo Project	7.1
SF-2	Quinali (A) River System Sabo Project	11.0
SF-3	Buang River System Sabo Project	0.3
SF-4	San Vicente River System Sabo Project	3.7
SF-5	Padang River System Sabo Project	2.4
SF-6	Basud River System Sabo Project	1.7
SF-7	Bulawan River System Sabo Project	1.2
River Improvement		
RI-1	Yawa River Improvement Project	1.1
Urban Drainage		
UD-1	Legazpi City Urban Drainage Project	1.7
Forecasting, Warning and Evacuation		
FW-1	Forecasting, Warning and Evacuation System Strengthening Project	82.2
Relocation/Resettlement		
RR-1	Relocation and Resettlement Projects	5.4
Total		117.8

5.4 Project Evaluation and Priority Ranking

(1) Project Evaluation

To screen out the candidate projects, the economic evaluations for the alternative plans were preliminarily carried out with regard to the Sabo projects (options 1 to 3), flood control and urban drainage projects by return period. As the result of evaluation, the Option 3 for 20-year return period was selected. The economic internal rates of return (EIRR) for all flood control projects (20-year return) were not viable indicating lower than 15%, while that of the Legazpi City Urban Drainage Project showed a very high economic viability working out at 23.96%.

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

Results of Economic Evaluations for the Alternative Plans

River system	Option No.	Return Period (Year)	EIRR (%)	B/C	NPV (15%) (Milli. 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 Projects					
Yawa River	-	20	10.08	0.65	-65.9
Quinali (B) River	-	20	5.66	0.38	-555.0
San Vicente River	-	20	6.47	0.43	-112.0
Nasisi River	-	20	5.23	0.36	-365.0
Ogsong River	-	20	6.10	0.41	-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

Notes: Conditions for Economic Evaluation - ① Evaluation period: implementation period + 50 years, ② Discount rate: opportunity cost of capital (15%)

(2) Selection of the Priority Projects and Programs

To screen out the priority projects among the proposed ones, an evaluation criteria for their prioritization was established and used, referring to the formulated basic concept and strategies and through discussion with the authorities concerned. These consist of (a) imminence of disaster impact, (b) economic feasibility (EIRR), (c) social impacts (no. of beneficiaries and affected people), and (d) representation as a model.

The prioritization results of the core projects and programs are given in the following table.

Master Plan Projects/Programs and Their Prioritization.

Code No.	Projects/programs	(1) Urgency of Implemen-tation	(2) Economic Advantage (EIRR)	(3) Social Impact (No. of Beneficiaries)	(4) Degree of Represen-tation as Model	Total Scores (Accumulated Points)
Sabo Facility Construction						
SF-1	Yawa River System Sabo Project	A	A	A	A	20
SF-2	Quinali (A) River Sabo Project	B	B	A	B	14
SF-3	Buang River Sabo Project	C	A	C	B	10
SF-4	San Vicente River Sabo Project	C	B	C	B	8
SF-5	Padang River Sabo Project	B	B	A	A	16
SF-6	Basud River Sabo Project	B	C	C	B	8
SF-7	Bulawan River Sabo Project	C	B	B	B	10
River Improvement						
RI-1	Yawa River Improvement Project	B	C	B	C	8
Urban Drainage						
UD-1	Legazpi City Urban Drainage Project	A	A	A	B	18

Notes: (1) Urgency of Implementation A: High, B: Medium, C: Low
(2) Economic Advantage (EIRR) A: >20%, B: 15 - 20%, C: <15%
(3) Social Impact (No. of Beneficiaries) A: >500, B: 200 - 500, C: <200
(4) Degree of Representation as a Model Project A: Large, B: Medium, C: Small
Accumulated Scores: A=5 points, B=3 points, C=1 point

Based on the key factors for selection of the livelihood projects such as (a) labour-intensive or employment creation, (b) utilization of local resources (materials and expertise), (c) prospects of marketability, and (d) availability of the utilities (water and energy), the following enterprises or projects are promising and will be taken up in the Feasibility Study.

1) Increase in Agricultural Productivity and Production

- Coco-based inter-cropping with banana, abaca, corn, pilinuts, root crops, vegetables and others
- Increase in paddy production

2) Promotion of Agro-industry and Agribusiness

- Handicraft (abaca, nipa, caragumoy, etc.) and furniture making (pili tree, bamboo, etc.)
- Coco coir production (coco fibre, twine, dust or peat, etc.)
- Food processing (pilinuts, fruits, vegetables, etc.)

As to the institutional and supporting services strengthening, the following programs will be focused and scrutinized in the Feasibility Study.

a. Clarification of the duties and responsibilities about forecasting and monitoring of mud and debris flows
b. Establishment and strengthening of the operations and maintenance (O&M) of the constructed structures and installed facilities
c. Upgrading of the forecasting, warning and evacuation system
d. Awareness promotion of the people

5.5 Organization for Implementation of the Proposed Programs and Projects

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 will be responsible for coordination of all matters relating to the overall implementation of the Master Plan projects and programs. The main activities of the PMO are coordination among the agencies and authorities concerned in charge of projects/ programs implementation, control of their performance, application and allocation of annual budgets, holding of the disaster-related conferences & seminars, execution of training programs at every administrative level, and so on.

At the provincial level, the Provincial Disaster Coordinating Council (PDCC) will take charge of coordination and management of the inter-city/municipality projects and programs. The Provincial Disaster Management Office (PDMO) will act as PDCC's Secretariat. At the city/municipality level, a "City or Municipality Coordinating Council (C/MDCC)" under the control of Mayor will be consolidated so that the Council can coordinate and monitor the component projects/programs proposed in the "Community-based Disaster Management Strengthening (CP-1)".

5.6 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 (on the next page). As shown in this figure, the construction work schedule for Sabo facility extends over one year and half to three years depending on its scale, while flood control and urban drainage works take one year and half to two years.

Besides, it is prerequisite that the resettlement site development projects packaged with livelihood programs be completed before implementation of the physical projects, or the eligible resettlers should be properly compensated and/or assisted so that their economic and social conditions would be as favorable as before.

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
Sabo Facility Construction																							
SF-1	Yawa River System Sabo Project																						
SF-2	Quinali (A) River System Sabo Project																						
SF-3	Buang River Sabo Project																						
SF-4	San Vicente River Sabo Project																						
SF-5	Padang River Sabo Project																						
SF-6	Basud River Sabo Project																						
SF-7	Bulawan River Sabo Project																						
River Improvement																							
RI-1	Yawa River Improvement																						
Urban Drainage																							
UD-1	Legazpi City Urban Drainage Project																						
Forecasting, Warning and Evacuation																							
FW-1(1)	Forecasting, Warning and Evacuation System Strengthening																						
FW-1(2)	Strengthening & Development of Remnant Rainfall Gauging Stations and Evacuation Centers																						
Relocation/ Resettlement																							
RR-1	Relocation and Resettlement Projects																						
Institutional and Supporting Services Strengthening																							
NP-1	National and Regional Disaster Management System Strengthening																						
PP-1	Provincial Disaster Management System Strengthening																						
PP-2	Province-wide Socioeconomic Development and Monitoring																						
CP-1	Community-based Disaster Management Strengthening																						
CP-2	Livelihood Development Projects and Programs																						

Notes : Feasibility Study or Preparatory Study
Construction Works and/or Installation of Equipment
Detailed Design or Preparation of Works
Project Activity or O&M including Monitoring and Review

5.7 Project Sustainability Assessment

(1) Economic Viability

The Sabo plan for the Yawa river system and also other river systems, river improvement plan for the Yawa river, and Legazpi City urban drainage plan are highly economically viable according to the economic evaluation. The degree of contribution of these plans to socioeconomic sustainability depends much on

whether the development in protected area which is planned as Option 3 for land use plan could extract the potentiality inherent in the hazardous area to be protected from volcanic or flood disaster.

According to land use plan of Option 3, the following impacts are expected:

- The enhancement of agricultural productivity is expected for major agricultural crops such as palay, coconut (copra), and vegetables.
- New areas for industrial and service sector are planned and from these lands, agro-industrial products with high value added is expected to increase and trade industry including distributing these products in the form of transportation, wholesale and retail service will be accelerated.
- Tourism will be more activated by implementation of disaster prevention. Especially Mayon Volcano is expected to be the most important trigger of regional economic prosperity by expansion of disaster free zones in the Study Area.
- The feeling of freedom from disaster of residents could be a fundamental factor of their daily lives. At the same time, this fact will promote/ accelerate the socio-economic development of the protected area.

From these impacts, the projects in the Master Plan are expected to extract the potentiality of the Study Area and contribute considerably to socioeconomic sustainability of the area.

(2) Operations and Maintenance of the Disaster Preventive Structures

The Project Management Office (PMO) will be established for implementation of the proposed projects and programs. The PMO will be led by DPWH Region V. Collaboration and coordination with various national government agencies, provincial, municipal and city governments (LGUs) will be required. The organizational setting will be studied further in the Feasibility Study. Though LGUs will not cover investment cost, active involvement of LGUs in project implementation and O&M will be considered.

(3) Environmental Impacts

The indirect effects and socioeconomic and cultural impacts would be produced by the implementation of the projects and programs proposed in the Master Plan.

The disaster prevention/ mitigation projects proposed in this Master Plan will generally have a positive impact on the environment. The construction and

rehabilitation works of the disaster preventive facilities are mostly designed to improve environmental conditions in the disaster prone areas. The improvement of such basic infrastructure will prevent the occurrence of disasters and mitigate their effects.

In addition to the physical impacts, the following socioeconomic and cultural impacts will be brought about subsequent to the implementation of the Master Plan projects and programs:

- Increase in agricultural productions and development of their processing industries
- Generation of employment opportunities
- Improvement of the people's living standards (especially those living in disaster-prone areas
- Expansion of business chances
- Promotion of WID (women in development)
- Other socioeconomic (multiplier) effects

As to the increase in employment opportunities, which is the most imminent socioeconomic issue to be addressed and conductive to the improvement of resettlers' living standards, about 3,500,000 man-days of job opportunities are expected to be generated if all the Master Plan projects and programs are implemented by the target year of 2020.

CHAPTER 6 PRIORITY PACKAGE AND RECOMMENDATIONS

6.1 Priority Projects and Supporting Programs

The projects and programs recommended to be immediately executed in this Master Plan are combined as "Priority Package" and subjected to a feasibility study in next phase. The Priority Package consists of : (a) Yawa River System Sabo Project, (b) Legazpi City Urban Drainage Project, (c) Forecasting, Warning, and Evacuation System Strengthening Project, (d) Resettlement Sites Development Project (at two sites: Banquerohan in Legazpi City and Anislag in Daraga Municipality), and (e) Institutional and Supporting Services Strengthening Programs and Projects.

This Priority Package is to be implemented during Phase I (up to 2005), but before its implementation, more than one year is needed for the detailed design and/or preparation of the works such as formulation and approval of the projects/ programs as well as budgetary arrangement.

6.2 Recommendations

For a more successful implementation of the Master Plan projects and programs, the following are particularly recommended:

<u>For the Master Plan Projects and Programs</u>

1) As the disaster prevention/ mitigation measure or project is an integral part of the area socioeconomic development, the government is advised to allocate the required fund to the disaster prevention in proportion to area development;
2) To implement duly the Master Plan projects and programs, it is recommended for the government to tap a funding source and have recourse to the cooperation of the local government units (LGUs) to raise a necessary fund to implement the projects;
3) With a view to ensuring the soundness and sustainability of the Sabo and flood control projects, maintenance of their structures has to be given priority, especially for the existing facilities damaged by calamities;
4) In view of the incessant or unforeseen change of the volcano and river conditions, the Sabo and flood control planning and design should be regularly reviewed, especially after every disaster occurrence. As to the frequency of updating the Master Plan, it is suggested to do it at least every 10 years in the case of no remarkable changes;

5) To upgrade the "disaster management capacity" of the communities, the information management system needs to be strengthen through provision of the forecasting and warning facilities, and transmission and dissemination of accurate, timely and clear information;
6) As the public awareness plays an important role in coping with crisis situations, the programs of disaster education in schools and assistance in educating the public should be provided for the benefits of long-term mitigation;
7) The government and the community need to act together to overcome the crises which arise from disaster and to ensure a rapid return to normal conditions. Likewise, it is important to have for both parties a common understanding of the scope and limitations of the respective responsibilities and duties;
8) Any engineering schemes are to be supported by social development programs to encourage the participation of the community in the projects/ programs;
9) To assure the sustainability of the proposed projects and programs, social preparation needs to be carried out beforehand by sparing enough time to encourage the participation of the community or local people;
10) In view of the potential risk of the volcano's eruption, the people still residing within 6km-radius from the crates are strongly advised to be resettled in safer places where livelihood programs are well provided;
11) To support and promote the livelihood development, it is suggested to implement employment generation programs as a safety net measure, coupled with micro-finance programs that are designed to have the greatest outreach and reach the poorest segments of the population; and
12) As the master plan projects and programs include both the structural and non-structural countermeasure components, it is suggested for their operations and management to establish a "Project Management Office (PMO)" composed of the representatives from the government agencies such as LGUs, DPWH, OCD, PHIVOLCS, DSWD, etc. and the private sector including NGOs.

<u>For the Priority Package Projects and Programs</u>

13) In view of the imminence and socioeconomic effects of the priority package projects and programs, it is strongly recommended to set about their works and activities as quickly as possible;

14) Implementation of the institutional and supporting services strengthening programs is indispensable to the successful performance of the physical projects and their sustainability. Therefore, the latter needs to be implemented as a package and still abreast together with the former;
15) In the Philippines, no legislation stipulates for the monitoring of mud and debris flow. To cope with such imminent disaster threat, it is advised to establish immediately an "Inter-agency Committee", which takes charge of the mud and debris flow monitoring and warning; and
16) The Master Plan proposals are advised to be disseminated widely to facilitate implementation and to cultivate public acceptance through implementation of the orientation seminars and workshops, information displays, preparation of publicity materials such as posters and videos together with the newly prepared "hazard maps".

To support the Five Anchor Projects, the Eight typical supporting Projects and Programs are proposed to be implemented abreast. These are:

Livelihood Development for Resettles (Linked with Resettlement Sites Development

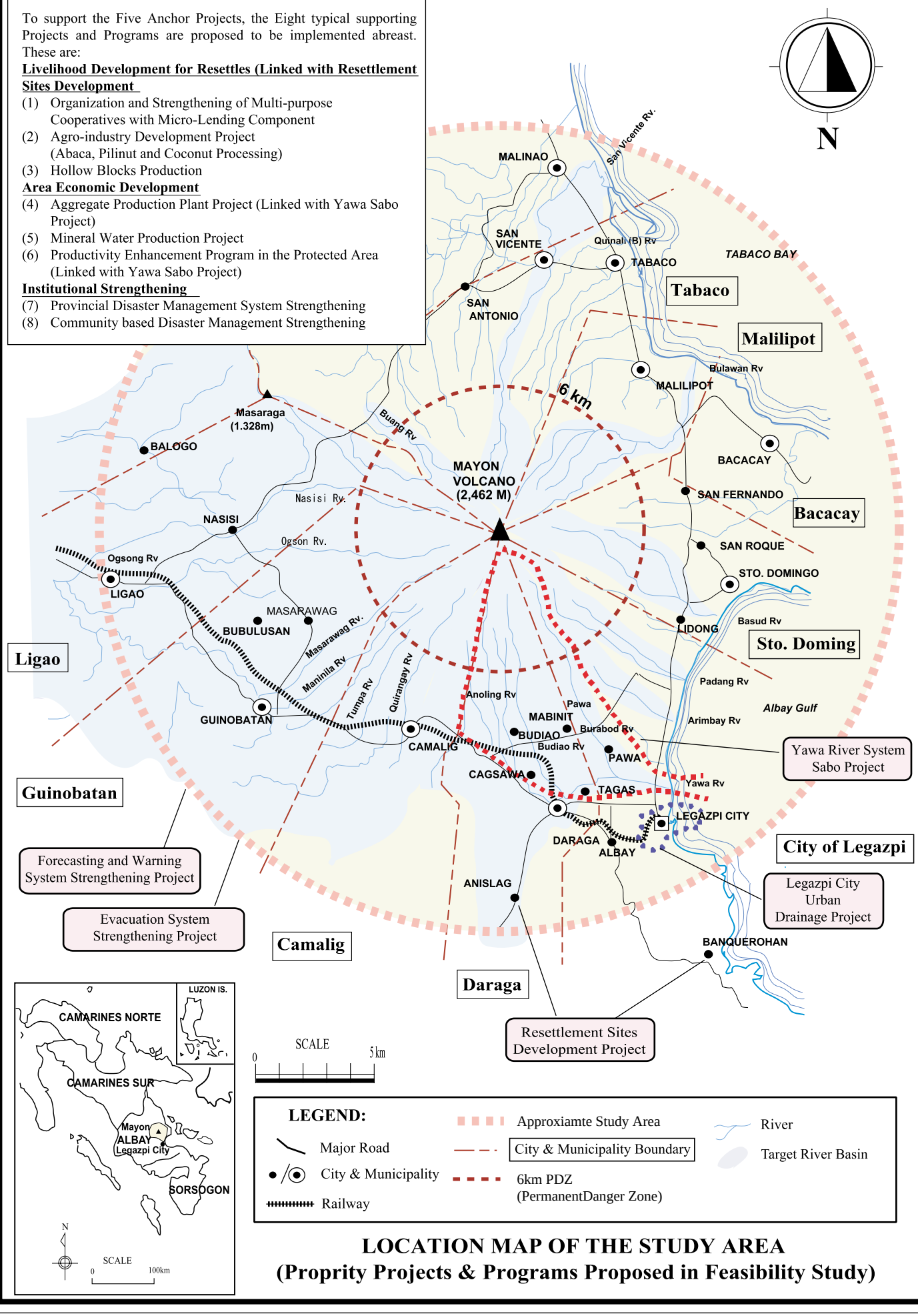
(1) Organization and Strengthening of Multi-purpose Cooperatives with Micro-Lending Component
(2) Agro-industry Development Project (Abaca, Pilinut and Coconut Processing)
(3) Hollow Blocks Production

Area Economic Development

(4) Aggregate Production Plant Project (Linked with Yawa Sabo Project)
(5) Mineral Water Production Project
(6) Productivity Enhancement Program in the Protected Area (Linked with Yawa Sabo Project)

Institutional Strengthening

(7) Provincial Disaster Management System Strengthening
(8) Community based Disaster Management Strengthening



LOCATION MAP OF THE STUDY AREA
(Proprity Projects & Programs Proposed in Feasibility Study)