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

Final Report

Volume III-2
Supporting Report

September 2003

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

Japan International Cooperation Agency

List of Volumes

Volume I : Executive Summary

Volume II : Main Report

Volume III-1 : Supporting Report

Appendix I : Socio-economy
Appendix II : Topography and Geology
Appendix III : Meteorology and Hydrology
Appendix IV : Sediment Balance
Appendix V : Inundation and Damage
Appendix VI : Sabo/Flood Control Structural Measures
Appendix VII : Road Network
Appendix VIII : Sabo/Flood Control Non-Structural Measures

Volume III-2 : Supporting Report

Appendix IX : Community Disaster Prevention System
Appendix X : Construction Plan and Cost Estimate
Appendix XI : Environmental Assessment
Appendix XII : Economic Evaluation
Appendix XIII : Institution
Appendix XIV : GIS
Appendix XV : Transfer of Technology

Volume IV : Data Book

Exchange Rates

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

Average of July 2002

APPENDIX-IX

Community Disaster Prevention System

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

FINAL REPORT

SUPPORTING REPORT

APPENDIX IX COMMUNITY DISASTER PREVENTION SYSTEM

Table of Contents

Page

CHAPTER 1 FRAME WORK OF CDPP IX-1
1.1 Basic Concept of CDPP IX-1
1.2 Objectives and Framework of CDPP: Livelihood Support IX-2

CHAPTER 2 FIELD INVESTIGATION AND NEEDS ASSESSMENT IX-4
2.1 Household Interview Survey IX-4
2.2 PCM Workshop IX-5
2.2.1 Objectives and Outlines IX-5
2.2.2 Workshop No.1 in Resettlement Centers in Botolan IX-7
2.2.3 Workshop No.2 in the Middle Stream of the Bucao River IX-8
2.2.4 Workshop No.3 for NGO Resettlement Centers in San Felipe IX-8
2.2.5 Workshop No.4 for Mountain Area IX-9
2.2.6 Workshop No.5 for Middle Stream of the Sto. Tomas River IX-9
2.2.7 Conclusions on PCM Workshops IX-10
2.3 Poverty Assessment through Barangay Comparative Study IX-11
2.3.1 Objective of the Comparative Study IX-11
2.3.2 Approach and Methodology IX-11
2.3.3 Conclusions on Poverty Assessment IX-12

CHAPTER 3 PROPOSED PROJECTS UNDER CDPP IX-14
3.1 Community Infrastructure Development at Tektek Resettlement Center IX-14
3.1.1 Results of Detail Field Investigation IX-14
3.1.2 Land Registration of NGO Resettlement Centers IX-15
3.1.3 Conclusions on Integration of NGO Resettlement Centers IX-16
3.2 Extension of Community-Based Forest Management IX-17
3.2.1 Basic Concept of CBFM Program IX-17
3.2.2 Present Condition of CBFM in the Study Area IX-17
3.2.3 Potential Development Area of CBFM in the Study Area IX-18
3.2.4 Priority Area on CBFM Extension IX-19

3.2.5 Cost and Benefit Estimation on the Priority CBFM Extension IX-21
3.2.6 Economic Evaluation on the CBFM Program IX-23
3.3 Agriculture Development on Lahar Area IX-24
3.3.1 Research Procedures / Methodology IX-24
3.3.2 Previous Studies regarding the Lahar Agriculture IX-25
3.3.3 Soil Condition on Lahar Area IX-26
3.3.4 Groundwater Level and Quality on Lahar Area IX-28
3.3.5 Interview to Farmers on Lahar Area IX-30
3.3.6 Selection of Appropriate Crops for Lahar Area IX-31
3.3.7 Key Issues for Development Plan Formulation IX-32
3.3.8 Proposed Development Plan for Lahar Agriculture Development IX-34
3.3.9 Cost and Benefit Estimation IX-36
3.4 Community Development in the Mapanuepe Lake Basin IX-37
3.4.1 Proposed Development Plan IX-37
3.4.2 Major Issues for Mapanuepe Lake Basin Development IX-38
3.4.3 Water Quality Survey IX-38
3.4.4 Conclusions for the Feasibility Study IX-40
3.5 Community Road Rehabilitation in Bucao IX-40
3.5.1 Needs on Rehabilitation of Community Road IX-40
3.5.2 Proposed Community Road Rehabilitation Network IX-41
3.5.3 Feasibility Design for Community Road Development IX-43
3.5.4 Assessment on the Project Benefit IX-44
3.5.5 Priority Route for Community Road Development IX-46
3.6 Establishment of Aeta Assistance Station IX-47
3.6.1 Background of the Project IX-47
3.6.2 Problems and Issues IX-47
3.6.3 Project Formulation IX-48
3.6.4 Project Implementation by NGO IX-50
3.6.5 Details of the Project IX-50

List of Tables

		Page
Table 2.1.1	Results of Household Interview	IX-T1
Table 2.3.1	Results of Barangay Ranking Study	IX-T2
Table 3.2.1	List of CBFM Projects in the Study Area	IX-T3
Table 3.2.2	Monitoring and Evaluation of CBFM Projects in the Study Area	IX-T4
Table 3.2.3	Economic Evaluation on CBFM Program for Community Based Disaster Prevention Activities	IX-T5
Table 3.3.1	Results of Laboratory Test of Soil Samples for Lahar Agriculture Research	IX-T6
Table 3.3.2	Laboratory Results of the Groundwater Survey of Water Wells	IX-T7
Table 3.3.3	Cost Estimate for River Training Works for Lahar Agriculture Development	IX-T8
Table 3.3.4	Market Price, Expenses and Net Income for Selected Crop Produces	IX-T9
Table 3.3.5	Construction Cost for Farm Land on Lahar Covered Riverside Area	IX-T10
Table 3.4.1	Results of Water Quality Survey at Mapanuepe Lake and the Reservoir of Dizon Mine Tailing Dam	IX-T11
Table 3.4.2	Results of Bed Material Quality Survey for Mapanuepe Lake and Reservoir of Dizon Mine Tailing Dam	IX-T12

List of Figures

		Page
Figure 1.1.1	Improvement of Basin Natural Condition between 1992 and 2002	IX-F1
Figure 1.1.2	Family Income Comparison between 1990 and 2002 in the Study Area	IX-F2
Figure 1.2.1	Objectives and Framework of the CDPP	IX-F3
Figure 1.2.2	Procedures to Upgrading Disaster Management Capabilities on Poor Communities	IX-F4
Figure 2.2.1	Target Area of PCM Workshop	IX-F5
Figure 2.2.2	Problem Analysis of Workshop No.1 (Resettlement Centers in Botolan)	IX-F6
Figure 2.2.3	Problem Analysis of Workshop No.2 (Affected Areas on the Bucao Upstream)	IX-F7
Figure 2.2.4	Problem Analysis of Workshop No.3 (NGO Resettlement Centers in San Felipe)	IX-F8
Figure 2.2.5	Problem Analysis of Workshop No.4 (Pure Aeta Community in Mountain Area)	IX-F9
Figure 2.2.6	Problem Analysis of Workshop No.5 (Along the Sto. Tomas River)	IX-F10
Figure 2.3.1	Results of Cluster Analysis for Barangay Comparative Study	IX-F11
Figure 2.3.2	Results of Barangay Comparison Study (Poverty Ranking Map)	IX-F12
Figure 3.2.1	Location Map of On-going CBFM Project	IX-F13
Figure 3.2.2	Potential CBFM Area	IX-F14
Figure 3.2.3	Priority CBFM Development Area	IX-F15
Figure 3.3.1	Location Map for Soil Samples	IX-F16
Figure 3.3.2	Co-relation between Vegetation Condition of Lahar and pH	IX-F17
Figure 3.3.3	Co-relation between pH and Sulfate (SO4) Concentration	IX-F18
Figure 3.3.4	Co-relation between Iron (Fe) and Sulfate (SO4) Concentration	IX-F19
Figure 3.3.5	Location of Sampling Point of Groundwater for Laboratory Test	IX-F20
Figure 3.3.6	Potential Development Area for Agriculture Development on Lahar Area	IX-F21
Figure 3.3.7	Priority Development Area for Agriculture Development in Lahar Area	IX-F22
Figure 3.4.1	Community Development Plan for Mapanuepe Lake Basin	IX-F23
Figure 3.4.2	Location of water / bed material samples for Mapanuepe Lake / Dizon Dam	IX-F24
Figure 3.5.1	Proposed Community Road Network	IX-F25
Figure 3.6.1	General Plan for Aeta Assistance Station	IX-F26

CHAPTER 1 FRAME WORK OF CDPP

1.1 Basic Concept of CDPP

Community Disaster Prevention Plan (CDPP) is defined as one of the three major components of the master plan formulation in this study together with the structural and non-structural measures. But, there is a doubt why the community recovery / development activities should be included in the master plan of flood and mudflow control. Prior to discuss about the CDPP in details, it is necessary to discuss about the necessity of the CDPP program in the master plan formulation.

It has been more than ten years after the eruption of Mount Pinatubo, and the lahar flow in the western river basins were no more observed after 1996 except in July 2002 at the Bucao River which was due to collapse of the Maraunot Notch of Pinatubo crater lake. The amount of pyroclastic material was much decreased on the mountain slope on ten years after the eruption as compared landsat images compared in 1992 and 2001 as shown in Figure 1.1.1. Accordingly, it is concluded the basin conditions are improving year by year in terms of the potential of lahar occurrence.

On the other hand, the damaged communities caused by the eruption and the followed lahar events are still not fully recovered even 12 years after the. Figure 1.1.2 shows the trend of family income in the study area, which was divided into four areas, 1) Coastal area, 2) Sto. Tomas area, 3) Bucao area, and 4) Mountain area, for assessment of recovery progress of the rural economic activities. The details are as follows:

Estimated Trend of Family Income in the Study Area

Area / Description	Samples	Year 1990			Year 2002		
		Family Income	Differ. Fr. National Average	Differ. Fr. Poverty Line	Family Income	Differ. Fr. National Average	Differ. Fr. Poverty Line
National Average(*1)	Statistic	P.87,434	-	-	P.161,842	-	-
Poverty Line(*2)	Statistic	P.35,527	-	-	P.71,493	-	-
Study Area(*3)							
1) Coastal Area	Statistic	P.57,681	-29,753	+22,154	P.138,952	-22,890	+67,459
2) Sto.Tomas Area	40	P.79,654	-7,780	+44,127	P.44,631	-117,211	-26,862
3) Bucao Area	97	P.35,579	-51,855	+52	P.29,764	-132,078	-41,729
4) Mountain Area	33	P.25,662	-61,772	-9,865	P.15,360	-146,482	-56,133

Notes: (*1) For 1990: Per Capita GRDP (P.17,522) x Family Size (4.99), For 2002: National Statistic Year 2000 x 1.06^2

(*2) National Statistic Coordination Board (NSCB) data of Year 2000 taking into account of 6% of annual increase

(*3) Direct survey by the study team on Year 2003

It was found that the income growth along the coastal area became smooth as of 2002. The gap with the national average was decreased from P29,753 at 1990 to P22,890 at present. The economic activities along the coastal area in Zambales was seriously damaged by the eruption of Mount Pinatubo in 1991, the it has been restored because of the great efforts by the National, Provincial and Local Government as well as the people by promoting agriculture-based industry as well as tourism development. The coastal area can be defined as the economic development zone which is required to be protected by reliable structural measures against the further disasters related to flood and mudflow incurred by the Mount Pinatubo River basins. That would be feasible in the economic viewpoints.

On the other hand, the areas along the economic recovery along the Sto.Tomas and Bucao River and the upstream mountain basins are still seriously suffered by the damages due to the events of the Mount Pinatubo eruption.

For the Sto.Tomas area, the income level was rather higher than the coastal area, the annual family

income thereof was estimated at P 79,654 as of 1990, which was about 35% higher than the one of the coastal area. Because, the area was well developed by gravity irrigation system, which covered about 2,000 ha on the left side. Farmers generally practiced triple cropping of rice a year. However, the whole irrigation system was destroyed due to frequent attacks by mudflow to the area. The damages were quite serious to damage the agriculture communities by destroying the irrigation system, the whole farmland as well as the water resources. The irrigation facilities are still not rehabilitated as of 2002, and the farmers are currently producing rain fed or spring irrigation with single cropping of rice and others. The family income of the Sto.Tomas area was therefore dropped to P44,631 as of 2002, which is below the poverty line and still not be recovered even after 12 years from the eruption.

For the Bucao River area, the average family income before the eruption was estimated at P35,579, which was almost same as the poverty threshold. Most of the people in this area depend on the rice production utilizing the communal irrigation system with double rice cropping a year. After the eruption however, all the paddy field as well as the community access road to market along the river was buried due to the deposition of lahar material with more or less 20m. People was trying to shift the agriculture activities from rice to cash crops such as vegetables and fruits on the mountain slope, but problem is that they have no market to sell the products due to un-recovered community road. As a result, the average family income dropped to P29,764, which was far below the poverty threshold of P 71,493 as of Year 2002.

In the upstream mountain area, there are 22 pure Aeta communities, 16 in the Sto. Tomas and 6 in the Bucao basins. Their income level was below poverty threshold even before the eruption. It was estimated at P25,662 only 70% of the poverty threshold with P35,527 as of 1990. As of 2002, the average family income dropped to P15,360, which is just 60% as before the eruption. The current average family income of 2002 is far below the poverty threshold of P 71,493. The damages to pure Aeta people in the mountain area is not only economic aspects but many of them have lost family and community members at the time of eruption. Their entire heritage in the mountain was completed destroyed due to the thick lahar deposition. After 12 years from the eruption, many of pure Aeta people returned their original community, but re-construction of their livelihood as well as the destroyed culture due to eruption are still not commenced yet.

The reason why the community development activities under the CDPP program are required is that most of the people in the affected river basins are still suffered from the poverty incurred by the disaster events after the eruption. Disaster prevention activities against flood and mudflow would not be possible without food security for the community. Recovery of the livelihood and income generation measures for the further improvement are therefore essential in the affected river basins together with the structural disaster prevention measures to the downstream areas.

1.2 Objectives and Framework of CDPP: Livelihood Support

The proposed structural measures aim to prevent disaster caused by flood and mudflow from the Sto.Tomas and Bucao Rivers. The area to be protected is mainly at the coastal lowland area, in which economic activities such as agriculture-based industry and tourism are increasing year by year. The beneficial population is estimated at 146,374 direct to be protected from the flood and mudflow by dike raising and strengthen. The indirect benefit to secure the transportation of National Highway No.7, which is the one and only lifeline in Zambales, is also quite important for sustainable regional economic development.

The mid-stream area of the Sto. Tomas River will be also protected by the structural measures. But more important and urgent matter is to recover the livelihood as their family income was dramatically

decreased due to the previous disaster events after the eruption and the people are still suffering from the poverty.

No structural protection measures are proposed in the Bucao mid-stream area as well as the upstream mountain area as there is no remarkable economic activities, assets exist in the area to meet the huge investment for the structural measures. However, people in the area were the most severely affected by the disaster and they have still no way to recover their livelihood due to lack of available farmland as well as the access road to market for selling products. Their income level is currently seriously low, which is much below the poverty threshold. The livelihood recovery and income generation are therefore urgently required under the disaster prevention programs, as the poverty is more serious disaster rather than flood and mudflow.

Figure 1.2.1 illustrated the objectives and framework of the CDPP. As no structural disaster prevention measures are expected in the middle and the upstream of the basin, the people is required to perform disaster management mainly through the community participatory approach, for which the set-up and strengthening the community organization will be essential. However, those communities which are still suffering from the poverty can not act for disaster management effectively as they are not secured even for daily food. Therefore, the livelihood recovery and income generation activities should be the direct objectives for the CDPP.

Figure 1.2.2 shows the procedures on the upgrading disaster management capabilities in the community. Strengthening the community organization through the community development activities should be designed through the CDPP, which will achieve to upgrade the disaster management capacity with improvement of economic condition.

Integration of the structural measures for lowland area as well as the livelihood recovery and income generation measures in the mid-stream and the upstream mountain area as the CDPP is therefore strongly recommended.

CHAPTER 2 FIELD INVESTIGATION AND NEEDS ASSESSMENT

2.1 Household Interview Survey

An interview of households was conducted within the disaster prone areas. The objectives of the household survey were to find out the problems, issues and, the needs for development, and also to assess the response to the disaster prevention issues. This is the basis for formulation of the CDPP. The survey area is widespread in the eight municipalities. A sample of 40 HH was selected at random from each municipality for the survey. Total number of samples was approximately 300.

The results of the survey is shown in Table 2.1.1 and summarized as follows:

(1) Actual/Required Income

With respect to the actual income level, about 60% of the sample answered that their average monthly income is less than 3,000 Pesos, which is only 25% of the average monthly family income in the Philippines (at 12,000 Pesos). However, 75% of the sample indicated that they need 5,000 to 10,000 Pesos of monthly income to live on. The gap between required and actual income was significant.

(2) Income Source

The major income sources are as follows:

Major Income Sources

No.	Income Sources	Sample number	Percentage of total sample
1	Agriculture	107	38%
2	Vending	34	12%
3	Hired labor	33	12%
4	Honorarium	28	10%
5	Small business	21	7%
6	Others	60	21%
	TOTAL	283	100%

It was found that agriculture is the main income source in this area for approximately 40% of the sample. Vending and hired labor followed agriculture at 12% each. Accordingly, more than 60% of the sample depend agriculture, vending or hired labor for their income sources. Improvement of agriculture will therefore be an effective means of improving economic conditions in the area.

(3) Projects Required to Rehabilitate and Improve the Community

The interviewees were asked what projects were required to rehabilitate and to improve the community and the following responses were obtained:

Required Projects to Rehabilitate and Improve the Communities

No.	Required project for Community	Sample Number	Percentage of Total Sample
1	Livelihood	248	83%
2	Flood Control	159	53%
3	Drainage improvement	138	46%
4	Water supply	83	28%
4	Road improvement	83	28%
6	Irrigation	76	25%

A livelihood development program was the top response for the communities located within the damage

prone area, totaling 83% of the sample. The flood control and river improvement works followed the livelihood programs. It seems that the living standard of the affected people has still not recovered to the same level as before the eruption. Accordingly, the highest points were recorded for the livelihood program.

Flood control and drainage improvement followed the livelihood program. They should also receive a high priority as the area is in disaster prone area, and has experienced significant flood/mudflow damages since the eruption of Mount Pinatubo.

(4) Possible Disaster Prevention Activities Requiring Community Involvement

Interviewees were also questioned about the possible disaster prevention activities requiring involvement from the community. The responses were as follows:

Possible Disaster Prevention Activities Requiring Community Involvement

No.	Possible disaster prevention activity	Sample Number	Percentage of Total Sample
1	Warning / evacuation	97	39
2	Information dissemination	41	14
3	Livelihood programs	33	11
4	Micro financing	17	6
5	Public hearing / consultation	13	4
6	Disaster prevention seminar / training	8	3

It was found that few people have an interest in the disaster prevention activities. It may prove difficult to involve the community in the implementation of the disaster prevention projects where a participatory approach is required. However, the early warning and evacuation systems are expected to improve if more useful information, to judge the timing for evacuation. Based on the above, the installation of a telemetry warning system is expected to be effective for the area.

Based on the results of the survey, the following can be concluded:

Findings from Household Interview Survey

1) A livelihood program is important to improve the living conditions for the affected people, and it will also contribute towards upgrading disaster prevention capabilities. Taking into account that the majority of the people depends on agriculture sector on their income sources, a livelihood program under agriculture sector will be the most effective to improve the living standard in the communities severely affected by the lahar events.
2) An effective warning system may improve the evacuation activities. More useful information is required to disseminate the warning on time.

2.2 PCM Workshop

2.2.1 Objectives and Outlines

As it was understood that the CDPP is the essential components under the flood and mudflow control project of the western river basins of Mount Pinatubo, the detailed investigation was conducted to identify the specific problems/issues in the communities, which are scattered in the mid-stream and the upstream of the study area.

Project Cycle Management Workshops (PCM Workshop) were therefore conducted on the five (5) different places with the following manners:

Objective of PCM Workshop

(1) To explain the proposed structural measures for flood and mudflow control in the master plan. Important issue is the middle and upstream will not be protected against further disasters under the structural measure. The area covered by the structural measure is mainly low-land area along the national highway because of the remarkable economic activities with assets to meet for investment of the measures.
(2) To conduct detail investigation on the mechanism of the poverty on the middle and the upstream communities, and to find out the key issue to break the poverty spiral in the communities severely affected due to the disasters incurred by the eruption of Mount Pinatubo,
(3) To assess the capability of community for sustainable disaster management activities with the required supports from the outside,
(4) To collect data and basic information for the evaluation of the affect to poverty reduction through the project implementation.

Target Group of PCM Workshop

The PCM workshops were conducted to the following target areas and people:

Target Area and People for PCM Workshop

No.	Date of WS	Target Area	Target People	Attendants		
				Aeta	Filipino	Total
WS1	25 Jan. 2003	Resettlement Centers in Botolan	Resettled families in Baquilan, Tautog and Loob bunga.	37	15	52
WS2	28 Jan.2003	Mid-stream of Bucao River Basin	People, returned to the original barangay from resettlement centers	37	8	45
WS3	30 Jan.2003	Resettlement centers in San Felipe	Resettled people in Bantay Carmen, Lalek and Tektek	33	7	40
WS4	1 Feb.2003	Mountain Area	Pure Aeta people originally resided in the mountain	35	0	35
WS5	4 Feb.2003	Mid-stream of Sto.Tomas River	People which was most severely affected along the Sto.Tomas and Lake Mapanuepe	3	37	40
			TOTAL	145	67	212

The location of the target area is shown in Figure 2.2.1. The target areas and people were selected that the areas where the most severely affected by the previous disasters and seems that the recovery actions were still not successfully performed.

Aeta people were also focused because the western river basins of Mount Pinatubo were the heritage of pure Aeta people, and their traditional life style was forced to change due to the eruption of Mount Pinatubo. As shown in Figure 1.1.1 in Chapter 1, the family income in the mountain area was the lowest in the study area, and it was much below the poverty threshold. Thus it is considered that Aeta people was the most severely affected not only in the economic viewpoints but also in the sociological issues.

Problem Analysis and Assessment of Problem Tree

In the workshop, small groups with more or less 10 persons were formed and the problem analysis was conducted. Each group developed the problem tree with the different core problems. The core problems are given by the study team based on the interview results which was conducted prior to the workshop. The selected core problems were as follows:

1) No Livelihood

2) Lack of Social Services

3) Lack of Disaster Management Capability

In addition to the above three core problems, another core problem, 4) Disaster Damages to Indigenous People (Aeta) was also raised by the study team, and was discussed by the community leaders of Aeta People.

After the formation of problem tree by each group, the discussion was held by the participants including the solutions to the problems, possible activities under the initiative of People's organization, and required support from others were discussed.

2.2.2 Workshop No.1 in Resettlement Centers in Botolan

Target people in the WS-1 are the resettled people in government established resettlement centers in Botolan, which is Baquilan, Tautog and Loob bunga. There are 52 participants including 37 Aeta people.

The participants were divided into five small groups and the problem analysis and the solution were discussed. Group formation was made based on the life style of the people, 1) permanent resettlement group, 2) semi-permanent resettlement groups, which has two basis in the RC and the original barangays, and 3) Aeta leaders semi-permanent resettlement groups.

It was found that the majority of the resettlement people have two bases, one in RC and another in original barangays, which were 36 persons out of 52 (69%). This is because of lack of livelihood in the RC, and lack of social services and infrastructure in the original barangays.

Their lifestyle is therefore that the Resettlement Center is considered as the residential base and the original barangay as their livelihood measure and their spiritual hometown. They generally stay some days in the original barangay for farming on the slope and the rest to stay in the resettlement centers, which are available social services such as elementary schools and so on.

It seems that many of semi-permanent settlers in the RC may not leave from the resettlement centers even though some recovery activities in the original barangays are conducted. Because, all the resettlement centers are located rather convenient places in the municipality and they can use as the second house for access to the various social services. Problems in the resettlement centers are the lack of livelihood, particularly no available farmland for farmers. Those who settled permanently in the resettlement centers are usually have the permanent job other than the farming in and around resettlement centers such as school teacher, heath workers, tricycle drivers and so on.

The problem trees formulated by respective groups are shown in Figure 2.2.2. All the small groups raised to the livelihood issues as core problem. Major sub-problems are "No land title", "Lack of health & medicine", "Peace and Order" and "lack of various social infrastructures".

Since the resettlement centers are located in the downstream area of the Bucao River near the center of Botolan Township, the land was fully developed as paddy field and the available un-used land is quite limited. Agriculture land development as the livelihood program for the Resettlement centers is therefore difficult except to utilize huge area of lahar covered riverside or swampy lahar area along the river.

If the people are favorable to seek the job other than farming, however, there will be more opportunities, though some skill training will be required.

2.2.3 Workshop No.2 in the Middle Stream of the Bucao River

Target people in the WS-2 are the ones permanently returned from the resettlement centers to the original located in the middle stream of Bucao basin. There are 45 participants including 37 Aeta people. The original barangays they returned are Malomboy, Poonbato, Magisgis, Nacolcol, Palis, Burgos, Villiar, Moraza and Belbel in Botolan municipality.

Even though the resettlement area is convenient to access the various social services, they have closed the residents in the resettlement centers and permanently returned to the original barangay. According to the target people, the main reason to return is that no livelihood is available in the resettlement centers, which is the same reason that the semi-permanent settlers in the RC. It is still not clear how they choose the different solutions, "Return to the Original Barangay" or "Dual Bases in the RC and the Original Barangays", is still not clear. It may be depended on the sense of value of the individual family.

Figure 2.2.3 shows the problem trees developed by the respective small group. In this workshop, the core problems were given by the study team. Because, it was clear that the "No Livelihood" is the most serious and core problems for all the affected families from the results of the first workshop.

Based on the problem analysis, it seems that "Rehabilitation of Community Road from the Baquilan to upper Bucao", which existed before the eruption, may solve or mitigate most of the problems raised by the people. Improvement of access would make possible to provide social service to the upstream communities and makes easier to transport material & equipment for construction of community infrastructures. Matter of "Peace and Order" can be also mitigated by extension of the existing community road so that the security patrol by police will be easier.

2.2.4 Workshop No.3 for NGO Resettlement Centers in San Felipe

Target people in the WS-3 are the resettlement people in NGO resettlement centers or temporary evacuation centers in Tektek, Bantay Carmen and Lalek in San Felipe. There are 40 participants including 33 Aeta people.

These areas have been identified as the poorest condition of social infrastructure facilitated such as water, electricity, school and so on, and selected as the priority project for integration of the three resettlement centers / temporary evacuation centers to Tektek Area for improvement of community infrastructures. Many of participants belong to Aeta tribe, who settled in the mountain area before the eruption.

The differences between GO and NGO resettlement centers are that GO resettlement centers are officially recognized as resettlement center and the land ownership is under the government. The area is possible to turn over to the resettlement people in future as the permanent residential area. On the other hand, the status of NGO resettlement centers is not clear. There is no guarantee / agreement regarding the period of settlement, which is just like a temporary settlement in the evacuation centers.

Figure 2.2.4 shows the problem trees developed by small groups. Almost all the groups raised "No Livelihood" as core problem, and the cause problem is "No Land", from which it was understood that most of the people depended on the agriculture on their livelihood. In addition, "Lack of Basic Human Needs" such as drinking water, electricity, health, education and so on.

Even though the existing resettlement area was quite poor condition for social facilities, most of the people are rather negative mind to relocate to the other areas. Instead, they hope to improve the existing resettlement site. The three areas, particularly Bantay Carmen and Lalek are located along the national highway, and it was rather better access to the township and job opportunities in the town, which might be the main reasons that they prefer to stay.

The problem solution matrix, which contains Problem – Solution – Measures under people's initiative – Required Support from outside was developed by the small groups themselves. Their proposals were the rather self-reliance with minimum supports from the Government or NGO. "Establishment and Strengthen the People's Organization", and "Small Credit System" would be highly interested to this areas, which may be effective to solve / mitigate the existing problems.

2.2.5 Workshop No.4 for Mountain Area

Target people in the WS-4 are the Aeta People living in the upstream mountain areas. There are 35 participants. All of them belong to Aeta Tribe from 19 Aeta communities (Sitio) in the mountain area.

Figure 2.2.5 shows the problem trees developed by the small groups. Almost all the groups were selected "No Livelihood" as the core problem, even some groups were provided the difference theme for discussion by the study team. The causes of "No Livelihood" are due to "Lack of fund", "No Road" and "Poor Health Condition" according to the Aeta leaders (Chiften) group.

The group for discussion about disasters, "Fear" was selected as core problems, which was based on the experiences that they have lost many family members or friends due to the eruption of Mount Pinatubo.

Other major issues they have raised were "No Land for Farming" and "Lack of Education" and so on.

At the time of Problem-Solution discussion, it was found that their approach to solve the problems is basically self-standing approach with less expectation to support by the Government or NGO. The followings are the examples of their proposal solutions against the problems:

Herbal Plantation: As the countermeasures to lack of medicine. Japanese NGO introduced many kinds of herbal medicine for cough, cooling, scratch, cold, diarrhea and so on.

Volunteer Teachers for Aeta Education: To teach Aeta children for the Aeta's own tradition in addition to the standard education.

Bayanihan / Balicatan System: All the people in the community should participate to construct community road and irrigation without payment. But some capital for food provision for the volunteers will be required.

It is noted that the Aeta leaders commended that the proposed structural measures are only for low-land people and no benefit for the Aeta Communities, and they proposed that another project such as " Integrated Development Plan for Aeta Community" shall be implemented. The study team is seriously concerning about their suggestion as a component of the CDPP formulation in the Project.

2.2.6 Workshop No.5 for Middle Stream of the Sto. Tomas River

Target people in the WS-5 are the affected people along the Sto.Tomas River in the middle stream along the river and Mapanuepe Lake, such as Barangay Laoag, Rabanes, Santa Fe, San Rafael, Aglao and Buhawen There are 40 participants and most of them are non-Aeta people (3 of Aeta Tribe).

This area was damaged several times after the eruption such as submerged under the Lake Mapanuepe, buried by lahar on the whole community, dike breach on the left side, significant riverbed aggradation with more or less 7m, remarkable seepage water through the existing dike, break of spillway of Dizon Mine Tailing Dam, and so on. As the results, the people are still seriously worried about the further disasters even after 12 years from the eruption.

During the open forum, four measures questions / comments were raised regarding the Master Plan Formulation in this study:

1) Stability on the existing Sto.Tomas dike on the left bank. People settled along the dike was much worried particularly during the rainy season due to observed remarkable seepage water from the dike,
2) Possibility of closure of Mapanuepe Lake outlet (Darawana Channel). The outlet width was much decreased due to the flood in July 2002,
3) Collapse of Dizon Mine Tailing Dam. The spillway was completely collapsed during the last rainy season. Whether the whole dam body will collapse in coming rainy season or not.
4) Water quality of Mapanuepe Lake. There is a doubt that the lake water is highly contaminated due to the industrial pollution from Copper mining. No fish can survive in the lake even though many Tilapia fry were released.

Figure 2.2.6 shows the problem trees developed by the small groups. The core problems discussed were again about "Lack of Livelihood" as well as "Recovery of Agricultural Activities". Also some other issues as "Lack of Education", "Health Problem", and "No Preparation for Calamity" were raised as major problems.

During the Problem-Solution discussion, the various ideas were proposed. The followings are the examples of the proposed solution:

Tiger Glass Plantation as Livelihood Program: Tiger glass is the material for broom, which is so far not produced in Zambales. The tiger glass is easy to plant along the river, and it continues to bloom for 10 years.

Barangay Drugstore: To meet the lack of medicine, the barangay will collect 20 Pesos from all the barangay families, and drugstore cooperation shall be established.

Shifting School: As there is no school building, individual house will be utilize as shifting school one by one and the educated people in the barangay will be the volunteer teachers by shifting.

Livestock Credit: Loan will be required for initial investment, and the return will be made with an appropriate interest with 10 years grace period by increasing heads of livestock instead of capital.

The most important aspect for the formulation of community-based project, how to assure the sustainability of the project. The first step to secure the sustainability is to strengthen the People's Organization through the development activities with a certain self-responsibility. In this viewpoint, the aggressive groups for development activities such as the participants in this Workshop No.5 may have high possibility to realize sustainable community development project.

2.2.7 Conclusions on PCM Workshops

"Lack of livelihood" is always discussed as the main problem in the series of PCM workshops. This is because of no farm land for farmers and no other opportunities of income sources. Many farmers lost their farm land, which were buried by lahar together with their houses and properties in the original barangay.

Those who resettled in the resettlement centers developed by MPC, are however rather seems to be better condition although they are still suffering from lack of livelihood. The resettlement centers are generally facilitated the basic infrastructures such as elementary schools, water supply, health center/clinic, chapel, and barangay halls and so on, some of which were not available in the original barangays. Livelihood development in the resettlement center would be the only problems remained. On the other hand, there is a limitation of farm land availability, and some of resettled people are semi-returned to the original barangays to seek their livelihood. To improve the productivity and accessibility to their original barangay would be rather supportive for the permanent /semi-permanent resettled people.

Strengthening of disaster management capability seems to be not immediately possible in the study area without livelihood development activities. It is better that the formation of people's organization through livelihood development should be focused as the Community-Based Disaster Prevention as the first steps. The capacity building of the organization will be then realized for upgrading disaster management capability together with the livelihood development through the people's organization.

2.3 Poverty Assessment through Barangay Comparative Study

2.3.1 Objective of the Comparative Study

In this section, the effects on the poverty reduction in the study area by the proposed Flood/Mudflow control measures are assessed. This is for the purpose of searching the best arrangement of the projects, which is to aim equitable recovery and development in the study area. Generally, the target area of Flood/Mudflow control is focused the area in which more building, productive land, public facilities and population are concentrated. It seems that the proposed structural control measures could not cover the other area in the study area, in which less productivity, assets, development potential, building and population. Generally, there would be a limitation that the poor communities with less assets is difficult to protect by the structural measures because of the economic reasons.

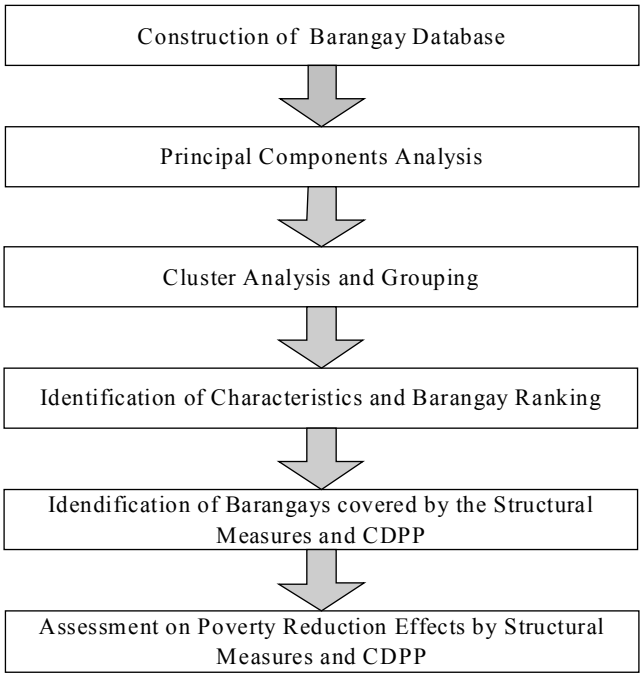
The proposed CDPP in this study, is not formulating for direct linkage to the disaster prevention activities, but to mitigate poverty on the severely affected barangays, that must be the best defense against the further disasters.

Objective of the Barangay comparative study is therefore as follows:

1) To identify the characteristics of the barangays in the both areas which is within the protected area by structural measures and out of the protected area,
2) To select the location of CDPP site, which is focusing poverty reduction for severely affected communities due to the events of the eruption of Mount Pinatubo and series of lahar.

2.3.2 Approach and Methodology

The following figure is the flow chart of the Barangay comparative study, for which the multivariate statistic analysis was applied:



First of all, the barangay database was constructed based on the GIS database of the study team and the barangay information. For the barangay comparison, 15 kinds of data were used for multivariate statistic analysis.

After then, the Principal Component analysis (PC analysis) was conducted. PC analysis is to assess the correlation between the respective data and to determine the principal components, which is the group of data with relatively high correlation. In this study, six principal components were extracted from the 15 kinds of data.

Cluster analysis is then conducted to classify the barangays. Based on the score of respective principal components, the barangays which marked the similar scoring pattern of respective principal component are grouped, and the characteristics of the each group are assessed.

The barangay ranking is determined based on the accumulated score of PC analysis, by which the characteristics of the respective cluster and the poverty degree is identified.

Based on the results of Cluster analysis, the assessment of the beneficial barangays by the proposed structural measures will be carried out. By this, the expected effects on the structural measure for poverty reduction will be assessed. At the same time, the CDPP plan formulation will be assessed based on the cluster analysis, for which the CDPP projects would be proposed for the area which are identified relatively low score of PC analysis and a certain cluster characterized as the poverty area. Then the poverty reduction will be focused as one of main objectives of the proposed CDPP.

The detailed procedures are mentioned in Appendix-XV GIS in the sector report.

2.3.3 Conclusions on Poverty Assessment

Based on the cluster analysis, poverty assessment in the study area is carried out. In this study, the principal components for the assessment are 1) accessibility for development, 2) suitability for agriculture, 3) degree of urbanization, 4) degree of education opportunity, 5) degree of infrastructure, and 6) per capita input from the government. Therefore, the poverty assessment will be limited only in the view of the six principal components mentioned above. In fact, the poverty structure is quite complex and not easy to quantify.

Based on the assessment in this study, the degree of poverty is assessed as the following orders:

Degree of Poverty

Order	Cluster	Characters	Nos. of Barangay	Poverty degree
1	Cluster-6	High Potential Barangay	4	Low
2	Cluster-2	Urbanized Agriculture Barangay	18	Relatively Low
3	Cluster-5	Urban Barangay	7	Medium
4	Cluster-4	Potential development Barangay	11	Medium
3	Cluster-1	Agriculture Based Barangay	66	Medium-High
6	Cluster-3	Less potential Barangay	16	High

The overall barangay ranking and scoring are shown in Table 2.3.1. The location of barangay classification is shown in Figure 2.3.1, and the poverty ranking map is shown in Figure 2.3.2.

Based on the assessment above, the barangays which are identified as high or relatively high degree of poverty are generally not suitable for agriculture development. Income source should be well studied taking into account the location and topography. Basically, the 16 barangays, belong to clusters 3, are located in the mountain area located far from the center of municipalities.

The slope agriculture method and/or agro-forestry would be therefore highly required to poverty reduction in this area, which would be directly contribute to improve the situation of barangays classified into cluster-3.

In addition, community road improvement to mountain areas would be another key factor to focus the poverty reduction in this area. The improvement accessibility would be quite effective to improve the condition of marketing, education access, as well as various services provided by the government.

CHAPTER 3 PROPOSED PROJECTS UNDER CDPP

3.1 Community Infrastructure Development at Tektek Resettlement Center

3.1.1 Results of Detail Field Investigation

Based on the questionnaire survey to the existing resettlement centers, which was conducted in the master plan stage, the differences in the living conditions between the governments established centers and NGO resettlement centers are obviously identified, which are suffering from the lack of community infrastructures such as elementary school, electricity supply, and community road in the NGO resettlement centers.

Priority	Resettlement Centers established by Government (Mt. Pinatubo Commission)	Resettlement Centers established by NGOs
No.1	Livelihood	Elementary School
No.2	Water Supply	Electricity Supply
No.3	Sewarage Treatment	Community Road
No.4	Public Health	Livelihood

In the government established resettlement centers, the livelihood development is the top priority needs, and community infrastructure developments are followed. On the other hand, the residents in NGO resettlement centers are required the community infrastructures rather than livelihood program. It means that the community facilities such as elementary school, electricity, water supply and so on, are not available at NGO resettlement centers.

The main reason for lack of community infrastructure is that the scale of NGOs resettlement centers is much smaller than the ones established by the government. The three government resettlement centers in Botolan municipality, which are Baquialan, Loob Bunga and Tautog, the number of families are more than 1,000, while the number of families in NGO resettlement centers is less than 100 each. The investment for the community facilities to such a small number of communities is rather difficult based on the viewpoint of the effective usage of the public budget. The idea of integration is therefore proposed to encourage development of community infrastructures those for the residents in the NGOs resettlement centers.

The proposed integration was discussed in the PCM workshop No.3 invited the representatives from the three NGO resettlement center. The participants however were apprehensive of the idea. They said they would prefer their present area of residence. It was suggested that the idea be presented to their community for further discussion. In order to get a more representative consensus, the study team came out with the perception survey to be conducted house-to-house among the residents of the three resettlement centers, Bantay-Carmen, Lalek and Tektek.

The perception survey was conducted on 15 February with a total number of samples of 105 families, which are equivalent 52.5% of the total number of families in the three centers.

As the results, more than 90% of the residents opposed to move to the other area rather than to stay in the present locations. On the other hand, about 30% of the respondents basically agreed on the idea for integration for better arrangement on social facilities though all of them insisted on their place as the area to integrate. The main reason for the positive comments is that the integration is expected to bring about improvement and social infrastructures.

The main reasons cited for disagreement to move are the followings:

a) They have means of livelihood in their present settlement,
b) Integration should be done in their present settlement,
c) They are used to the area,
d) They want their families to be together,
e) Their area is accessible to the highway and the schools,
f) They have established residence and other properties in their present area,
g) The prospective side does not offer land for farming.

3.1.2 Land Registration of NGO Resettlement Centers

Another particular issue in the NGO resettlement centers is the matter of land registration. All the government resettlement centers are established in the area owned by the government. Many of the residents in the center are currently acting to get land title of residential lots in the center. On the other hand, the land registration for the NGO centers are rather unknown, and the residential people are apprehensive whether they can permanently stay in the present area or not. The followings are the current conditions regarding the land registration for the three NGO resettlement centers:

1) Bantay-Carmen

About 400 hectares of Bantay-Carmen are classified as Lot-405 comprising agrarian reform lands under the jurisdiction of the Department of Agrarian Reform (DAR). These used to be part of the Barretto estate which fell under Philippine awards to previous tenant-beneficiaries. There are some 357 beneficiary / claimants to the area.

As a public land, the local barangay and municipal government have allocated some five hectares as public cemetery. Other unclaimed areas were allocated as reforestation areas. The present settlement area is also a prospective right-of-way (ROW) area for the re-alignment of the national highway.

There is a standing barangay resolution and supported by community petition, for the present residents to vacate the area. This is because the area was originally assigned as a public temporary evacuation area during calamities. The people around the Bantay-Carmen area are strongly opposing to the permanent occupation of the evacuation area in the public land.

2) Lalek

Sitio Lalek in Barangay Sindol, San Felipe is occupied by 97 Aeta families. They moved into the area in 1992 after Mount Pinatubo eruption as temporary evacuation. They originally came from Sagpat and Banawen in Barangay Maloma and Aglao in San Marcelino. They came to know of the area from earlier association with the Barangay Captain of Sindol who verbally allowed some original 18 families to resettle.

The present site is a public land classified as Lot-136 by the Bureau of Lands under the DENR. It is claimed as pasture land of the De Los Reyes family. This was subject to Court settlement in 1995 by the title holder to the 118 Aeta families to evacuate from the area. The DENR has allocated parts of the site to their Integrated Social Forestry program, which is currently under the CBFM program.

However, it was found that the no present residents were included in the member of the Lalek Upland Farmers Association, which is the title holder of the present CBFM area. The residents in Lalek are therefore no right to utilize the area even under the program of CBFM, which is depended on only agreement of the title holder.

3) Tektek

Tektek resettlement center is located at the coastal area at the river-mouth of the Maloma River on the left side. The area occupies about 3.8 hectares of public land. They had earlier coordinated with the DENR who informed them that P20,000 would be needed if they will occupy the area. In 1993, they made representations to the Municipal Mayor and the Philippine National Red Cross who worked for the establishment of the resettlement area. They have been awarded a collective title to the area by DENR subject to further parcellation and individual awards.

As mentioned in the above, the condition of land registration is rather serious issue in Bantay-Carmen and Lalek, and it is required to coordinate among the present residents, title holder group and the local government units for the further actions.

3.1.3 Conclusions on Integration of NGO Resettlement Centers

In the social viewpoints, the proposed integration of NGO resettlement centers will require more study particularly regarding the issue of land title. In this study therefore the proposed integration of NGO resettlement center is not feasible in the social and legal viewpoints though there is a strong need to solve these issues, which should be processed under the responsibility of the local government units.

The following further activities are recommended for the respective resettlement centers:

Bantay Carmen:

It seems that relocation of all 35 families are unavoidable as the present residential area was declared as the public land for highway and cemetery. The new places nearby the present residential area shall be identified by municipality of San Felipe with close coordination of the residents association. It is suggested to coordinate with the people's organization of Lot-405, which located behind the present resettlement area, to allow the 35 resettlement families to participate, and allocate some area in Lot-405 as the new resettlement area, if the 35 families are willing to do so.

Lalek:

The Lot-136 of CBFM area, in which the present lalek resettlement center exists, is titled by "Lalek Upland Farmers Association", but no forest management / production activities are observed. It is recommended that Department of Environment and Natural Resources shall coordinate between the Lalek Upland Farmers Association and the 97 Aeta Families in Lalek temporary evacuation area, to divide the area of Lot-136 into the two groups. The area is about 200 ha and wide enough to divide into two parts. At the same time, it is recommended to start appropriate activities by Lalek Upland Farmers Association for the community-based forest management as instructed by the DENR.

Tektek:

Tektek has less problems regarding the land title. The area can be registered as the permanent resettlement area. It is recommended that the Municipality of San Felipe shall assist to the 75 families for smooth processing of the registration of land. At the same time, the hatch production of Bangos, migratory fish in Philippines, is proposed as the main livelihood for the residents in Tektek, and the municipality is under development of Bangos hatchery in Tektek area. It is recommended that the municipality shall involve the residents in Tektek for the hatchery development as livelihood support measures.

3.2 Extension of Community-Based Forest Management

3.2.1 Basic Concept of CBFM Program

The nation-wide CBFM program is currently on-going as the effective measures for forest management under the concept of **"People first and sustainable forestry will follow"**. The Government believes that by addressing the needs of local communities, they will join hands to protect and manage the very source of their livelihood.

The CBFM program is therefore not a simple forestry program but integrated with the livelihood development program for the upland communities. Since the livelihood development is identified as the most urgent and essential for sustainable community-based disaster management activities, the extension of the CBFM program to the severely affected communities in the mountain was selected as the priority project in the master plan.

According to DENR, the ultimate goal on CBFM program is as follows:

1) Sustainable management on forest resources,
2) Social equity and welfare of communities, and
3) Strengthening partnership between DENR and local communities.

As the national strategy, the CBFM is applicable all the forest area in the country including the reservation area, of which no any private ownership right is identified. There are following characteristics in the CBFM program:

1) The people's organization will be given the utilization right of the forest for 25 years based on the agreement with DENR. It can be extended another 25 years after expiration of the first lease agreement,
2) Social equity will be given in top priority by DENR. The ownership and utilization of the forest resources should be equitable distributed all the members of People's organization, or among the People's organizations in the forest.
3) Partnership between DENR and LGUs are essential matter for successful implementation of the CBFM program. They are responsible for supporting and cooperation to the People's organization for forest management activities conducted by the People's organizations,
4) The government is responsible for participation in initial investment, and supporting to the promotion and marketing activities of the forest products.

Taking into account the above concept and objectives, the CBFM program would be one of the best measures to apply in this study for the further disaster prevention and sustainable basin management activities through livelihood development in the mountain area.

3.2.2 Present Condition of CBFM in the Study Area

In the province of Zambales, there are 31 existing CBFM projects, 12 of them are located within the study area covering the municipalities of San Felipe, Botolan and San Marcelino. In addition of the 12 on-going projects, the 16 CBFM project in the study area are waiting for the approval by DENR.

Table 3.2.1 is listed the registered / under-registered People's Organization (POs) for the CBFM, and the location of the CBFM area is shown in Figure 3.2.1.

The present status / activities of CBFM program is monitored by CENRO under the DENR and reported as follows:

1) **Loob-bunga Youth Development Corporation,** in Loob-bunga, Botolan, composed of 69 youth members started planting assorted forest trees from their established nursery in 1995 including

development of agro-forestry area planted with fruit bearing trees like mango, cashew and bananas. During the initial year of development, the People's Organization was able to establish a half hectare nursery in the approximately 50 hectares, but as of this year the organization collapsed due to migration of members to other places hence the project was abandoned. Some interested parties not members of the original organization are now taking care of the area and another organization is interested to apply in the same area.

2) **Cabatuan Upland Farmers Association,** composed of 126 household residing mostly adjacent to the project area is beneficiaries of CBFM in Tarangka and Pangunuhan, Cabatuan, Botolan, Zambales. The site is favorable utilized for upland agriculture with existing improvements like vegetable products and banana plantation. For area development and management, however, no plantation was established and there are no forested portions in the project area.

3) **Cabaruan Multi-Purpose Cooperative,** undertake the area in Sitio Cabaruan, Feria, San Felipe in Zambales. Most of the areas covered have been already planted with forest trees such as eucalyptus, acacia auriculiformis, narra, includes mango and cashew. Production forest is considered to the new plantation and development and planting is done through the efforts of the officers by community initiative to work as a group in the area. An achuete production was already established, a commodity product with promising income to participants once it bears fruits for market at the same time planting the area with this specie considered as an economic advancement.

4) **Lubos Na Alyansa Ng Katutubong Ayta Sa Zambales,** undertake the area in Sitio Bihawo, Monbong in Botolan, The area was developed into an agro-forestry system of development, in a communal ways of working group. On contours, farmers used bananas that serves as protection against erosion and water conservation including income generation product of the fruits for food supply and market (forest tree are planted in their watershed and or area for their domestic water supply in the adjacent community).

5) **Kapisanan ng Samahang Apektado ng Pinatubo sa barangay Cabatuan (KASAPI2000) Inc.,** of Loog-bunga, Mambong in Botolan is composed of 50 households members. The area covered 11 hectares under CCFS tenurial instrument. Beneficiaries were victims of Mount Pinatubo eruption from eastern barangay of Botolan and they belong to Aeta ethnic group. The CBFM area was tend to be safe and arable for upland agriculture. The site has an existing development and physical features such as agricultural crops, available water supply and moderate rolling terrain. However, for area development and management, no plantation was established and there is no forest portion in the project area.

As described above, some difficulties are found for the effective operation of the on-going CBFM projects, for which the strengthening the People's Organization is essential together with technical support for agro-forestry as well as contour farming. The respective PO should prepare the budget / benefit estimation long-term development plan aiming at income generation together with the better forest management.

Overall evaluation for the existing CBFM was conducted by the efforts between PENRO / CENRO and the study team. The results are compiled in Table 3.2.2.

3.2.3 Potential Development Area of CBFM in the Study Area

Potential development area of CBFM in the study area is identified as the following procedures:

1) All the forest, glass and bear land was listed from the GIS database as the initial potential area for development of CBFM,

2) The area which is highly affected by the pyroclastic deposit at the foothill of Mount Pinatubo, was excluded from the potential development area identified 1) above, which was identified from landsat image taken in 2002. Because, the area highly affected by pyroclastic deposit is still unstable in the geological viewpoint, and judged as not suitable for agro-forestry development yet. It is recommended that the area shall be included only after natural forest is recovered in future.
3) The gentle slope area with less than 30% was selected as the potential development area of CBFM from the identified area of 1) and 2). Because, the slopes more than 30% in the forest is not suitable for agro-forestry development in terms of the operation and maintenance activities. It is rather difficult to maintain the agro-forestry on the steep slope which was learned from the previous experiences of the CBFM project. Since, the immediate objective of CBFM proposed in this study is to develop the livelihood in the severely affected communities; it is proposed that the area which is not suitable for agro-forestry development is excluded from the priority area.
4) The 20% of the gentle slope area, identified in 2) above, is selected as the agro-forestry area, which is based on the instruction from DENR. As the ultimate goal of the CBFM program is to strengthen the forest management, the agro-forestry development in the forest area is limited up to 20% of the whole forest area.

Based on the above, the potential area for CBFM development in the study area was identified as shown in Figure 3.2.2. Total potential area is about 25,000 ha.

3.2.4 Priority Area on CBFM Extension

In this study, the CBFM program is identified as the livelihood support program for severely affected people due to the eruption of Mount Pinatubo. At the same time, improvement of the watershed condition of the three river basins is expected, in the view of effect on water retention in the basin, flood mitigation, and sediment yield mitigation.

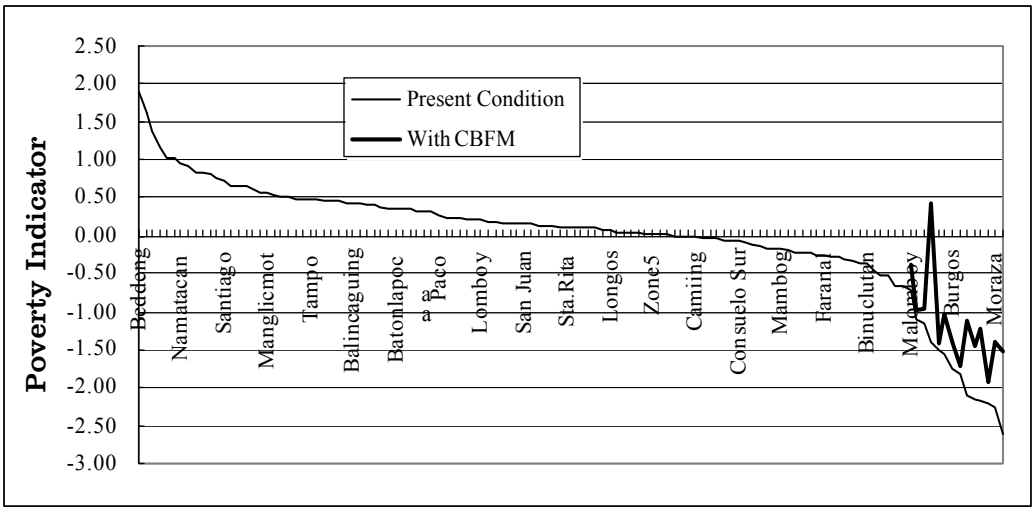
Based on the poverty assessment in the study area, mountain area in the Bucao and Sto. Tomas River basin are identified as the area which is the most severely suffering from the poverty aspects as described in Section 2.3. socio-economy. As described in the poverty ranking map shown in Figure 2.3.2, most of the barangays located in upstream of the Bucao and Sto. Tomas Rivers are given low ranking. On the other hand, the barangays classified as “Remote Barangay”, which is identified as the poorest barangays in the study area, have a large area of forest and recognized as high potential area on agro-forestry though the access to the market is so far not considered for assessment of the development potential. The following barangays are therefore recommended as the priority area for development of CBFM to improve the watershed condition through livelihood development activities.

Proposed Priority Area for CBFM Extension

No.	Municipality	Barangay	Barangay Ranking	Poverty Value	CBFM potential Area (ha)	Agro-Forestry Potential Area(ha)	Ranking after CBFM	Poverty Value after CBFM
1	Botolan	Maguisguis	122	-2.62	2,720	544	114	-1.54
2	Botolan	Moraza	121	-2.27	1,405	281	112	-1.40
3	Botolan	Villar	120	-2.20	745	149	117	-1.94
4	Botolan	Poonbato	119	-2.18	2,820	564	112	-1.24
5	Botolan	Palis	118	-2.14	745	149	113	-1.44
6	Botolan	Nacolcol	117	-2.11	1,145	229	111	-1.12
7	Botolan	Belbel	116	-1.84	240	48	115	-1.71
8	Botolan	Burgos	115	-1.74	520	104	112	-1.38
9	Botolan	Owaog-Nebloc	114	-1.55	480	96	110	-1.04
10	Botolan	Cabatuan	113	-1.49	145	29	113	-1.41
11	S-Marcelino	Santa Fe	112	-1.41	5,135	1,027	32	+0.43
12	S-Marcelino	Aglao	111	-1.15	550	110	110	-0.95
13	S-Marcelino	Buhawen	110	-1.10	240	48	110	-1.00
14	Botolan	Malomboy	109	-0.70	960	192	104	-0.39
	TOTAL				18,370	3,674		

Location of the priority area is shown in Figure 3.2.3. All the priority area is located in the upstream of the Bucao and Santo Tomas River basin. That is favorable in the view of watershed management for disaster prevention aspects such as improvement of water retention capability, flood peak mitigation and mitigation of sediment yield in the basin, though the priority area was selected from the viewpoint of the poverty reduction in the severely affected areas.

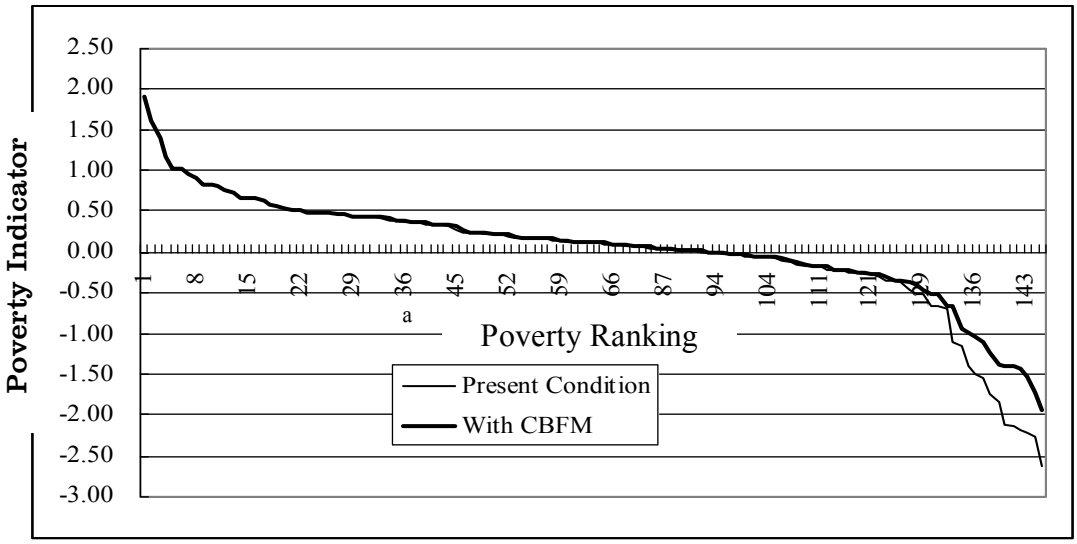
Poverty Reduction Effect by CBFM Program for the Priority Area



The above figure illustrated the effects of poverty reduction in the study area by introducing CBFM in the proposed area. The poverty indicator was developed in Section 2.3, and the poverty ranking was described in the bar chart. The last 14 barangays are selected as the priority area to develop the livelihood development. Because of agro-forestry development in the proposed area, the productive land is increased in each barangay, which is added for the poverty analysis to quantify the effect on poverty reduction effect by CBFM.

The distribution curve of the poverty indicator in the study area is then improved by promoting CBFM in the upstream of the Bucao and the Santo Tomas River basins as follows:

Poverty Reduction Effect by CBFM in the Study Area



3.2.5 Cost and Benefit Estimation on the Priority CBFM Extension

(1) Cost

Project cost for CBFM program is derived from the on-going forest sector project under DENR, which is financed by Japan Bank for International Cooperation. The cost per ha is as follows:

Project Cost per ha for CBFM

	Cost per ha (Peso)			Annual Cost per ha (Peso)				Breakdown			
	Material	Labor	Total	Year 1	Year 2	Year 3	Year 4	NO & PE	M & P	Others	Total
Reforestation											
(1) 5×2 m spacing	3,508	26,371	29,879	13,457	9,666	4,476	2,281	8,514	18,107	3,257	29,879
(2) 4×4 m spacing	2,636	17,612	20,248	9,182	6,633	2,905	1,527	5,517	12,187	2,544	20,248
Average	**3,072**	**21,992**	**25,063**	**11,320**	**8,150**	**3,690**	**1,904**	**7,016**	**15,147**	**2,900**	**25,063**
	12%	88%	100%					28%	60%	12%	100%
Agroforestry plantation											
(1) Agro: 10×10 m, trees: 2×2 m spacing	12,695	25,042	37,737	21,919	10,090	4,517	1,210	16,012	17,886	3,839	37,737
(2) Agro: 6×6 m, trees: 6×6 m spacing	14,728	18,040	32,768	19,087	7,196	3,943	2,542	15,085	14,212	3,471	32,768
(3) Agro: 4×4 m spacing	6,633	19,089	25,722	10,013	7,596	4,667	3,446	6,181	16,592	2,949	25,722
(4) Coffee: 3×3 m spacing	7,535	30,992	38,527	14,948	11,104	7,465	5,010	10,317	24,313	3,898	38,527
(5) SALT (Refo: 30% and Annual: 70%)	5,238	18,514	23,752	13,656	5,784	2,409	1,903	9,975	10,973	2,803	23,752
Average	**9,366**	**22,335**	**31,701**	**15,925**	**8,354**	**4,600**	**2,822**	**11,514**	**16,795**	**3,392**	**31,701**
	30%	70%	100%					36%	53%	11%	100%
Agricultural Land Conservation											
(1) Hedgerow (5 m interval)	**3,803**	**10,371**	**14,174**	**7,491**	**3,582**	**1,632**	**1,469**	**5,803**	**7,321**	**1,050**	**14,174**
	27%	73%	100%					41%	52%	7%	100%
Silvo-pasture											
(1) Grass & legume w/o fence	16,244	11,169	27,413	18,402	4,414	3,242	1,354	15,100	10,168	2,144	27,413
(2) Grass & legume w/ fence	16,884	13,996	30,880	19,570	5,890	3,967	1,452	15,100	10,678	5,101	30,880
(3) Grass & hedgerow w/o fence	17,496	14,417	31,913	19,792	6,197	4,341	1,584	15,542	13,894	2,477	31,913
(4) Grass & hedgerow w/ fence	17,977	16,189	34,166	20,462	7,074	4,904	1,726	15,756	15,765	2,644	34,166
Average	**17,150**	**13,943**	**31,093**	**19,556**	**5,894**	**4,114**	**1,529**	**15,375**	**12,627**	**3,092**	**31,093**
	55%	45%	100%	63%	19%	13%	5%	49%	41%	10%	100%

Note: NO & PE: Nursery Operation and Plantation Establishment,; M & P: Maintenance and Protection

Average cost for reforestation is estimated at P25,063/ ha, and Agro-forestry plantation is estimated at P31,701/ ha. The total cost for CBFM program on the priority development is therefore estimated as follows:

Estimated Cost for CBFM Priority Area Development

No.	CBFM Component	Unit Cost	Development Area	Project Cost
1	Agro-forestry plantation	P.31,701 / ha	3,674 ha	P.116,469,000
2	Re-forestation	P.25,063 / ha	18,370 ha	P.460,407,000
	TOTAL		22,044 ha	P.576,876,000

(2) Benefit

According to the on-going Forest Sector Project under DENR, the following benefit is considerable for the CBFM programs:

1) Stumpage value for controlled tree cutting
2) Sales of agro-forestry produce,
3) Fodder produce by silvopasture,
4) Conservation of agriculture land,
5) Harvest of firewood,
6) Incremental agriculture produce in dry season by increase of water retention capacity,
7) Flood mitigation effect with peak flow cut by increase of water retention capacity,
8) Prevention of sediment yield by increase of vegetative cover,
9) CO2 sequestration by tree and underground biomass.

Among the above, the following benefits are considered for the economic evaluation for CBFM program in this study:

1) Stumpage value for controlled tree cutting

Under the CBFM program, harvesting of trees in forest plantation is partially allowed to PO members in some extent under appropriate plan approved by DENR. In this study, Gmelina is assumed to plant in the re-forestation area, and the stumpage value of Gmelina is accounted as the productive benefit. The unit value of Gmelina is estimated at P119,144 /ha according to on-going Forest Sector Project under the DENR.

Harvesting is considered on 9 years after planting, and 20% of the plantation area will be harvested for five years. At the same time, re-plantation of Gmelina with the same area as harvested is considered.

2) Sales of agro-forestry produce

According to the DENR, the instruction to the PO was given that the 20% of CBFM area can be developed as Agro-Forestry area. Sales of agro-forestry produces is considered as the economic benefit of CBFM program in this is the main benefit of the project as CBFM is highly expected as livelihood development program for the people in the mountain area. Three kind of agro-forestry plantation, Mango, Cashew and Corn by SALT (Slope Agriculture Land Technology) are considered as agro-forestry development. Annual net income for respective products is considered as follows:

Assumed Net Income by Agro-forestry Products under CBFM

Harvesting year	Mango	Cashew	Corn (SALT)
Rate of Plantation	40%	30%	30%
5 year after plant	-P.2,718 / ha	-P.1,273 / ha	P.7,858 / ha
10 year after plant	P.1,044 / ha	P.10,663 / ha	P.7,858 / ha
20 year after plant	P.200,687 / ha	P.22,642 / ha	P.7,858 / ha
30 year after plant	P.194,463 / ha	P.22,642 / ha	P.7,858 / ha
Annual Value (Discount: 15%)	P.188,721 / ha	P.31,793 / ha	P.36,226 / ha

Source: Rstimated by Study Team based on the data from Forest Sector Project (DENR / JBIC)

3) Prevention of sediment yield in the watershed

Reduction of sediment yield in the watershed by promoting CBFM is considered as the CBFM area is covered by vegetation. According to the Japanese authorized textbook for forest management, the sediment yield in a forest mountain is assumed to be only 1% of a bare mountain. In the study area, it is estimated that the sediment yield in 2010 is 4.43mm /year in the Bucao River basin, and 5.49mm /year in the Sto. Tomas River respectively. Considering that the 50% of the sediment yield is mitigated by implementation of the CBFM instead of 99%, the volume reduction of sediment yield by CBFM is estimated as follows:

Sediment Yield Reduction Effect by CBFM Program

Watershed	Sediment Yield	Mitigation Rate	CBFM Area	Sediment Reduction Volume
Bucao	4.43 mm / year	50%	14,934 ha	661,576 m^3 / yr
Sto. Tomas	5.49 mm / year	50%	7,110 ha	390,339 m^3 / yr
TOTAL			22,044 ha	1,051,915 m^3 / yr

The value of reduction of sediment yield is considered by the alternative sediment reduction method by excavation of river channel. The unit price of channel excavation is estimated at P54.66 /m^3 in this study, which is included overhead of 20%. The economic value is therefore considered as 80% of the unit rate as P43.73/m^3. The annual economic value on the sediment reduction is then calculated as follows:

$$P43.73 / m^3 x\ 1,051,915 m^3 / yr = P46,000,243,/,year$$

The above effect on sediment reduction is considered from 10 years after commencement of the project.

3.2.6 Economic Evaluation on the CBFM Program

Based on the cost and benefit estimation as mentioned in Section 3.2.5, economic evaluation for the CBFM program was conducted. The economic life of the project is considered as 30 years. The discount rate for Net Present Value is applied as 15%, which is the same discount rate as the structural measures.

Table 3.2.3 shows the calculation sheet of economic evaluation. The EIRR is estimated at 21.5% with net present value of P253 million. The CBFM program under Community-Based Disaster Prevention is

therefore identified as the high viability project in the economic viewpoint. Moreover, the project is recognized as the highly effective program for the poverty reduction, which focuses the areas most severe living conditions in the study area.

3.3 Agriculture Development on Lahar Area

3.3.1 Research Procedures / Methodology

In the course of master plan formulation, it was found that the agriculture sector is the dominant to livelihood for the affected people due to eruption of Mount Pinatubo and the followed mudflow / flood events after 1991, and it is still not recovered for the productivity as before the eruption.

The drastic change of soil condition due to lahar deposition is one of the most serious issues by the farmers. Because of the lahar deposition on the farmland, the farmers were no more able to plant the same crops as before the eruption.

Agriculture development research is therefore conducted in the course of the study on flood and mudflow control as the following manners:

(1) Objectives

Objectives of agriculture development research are:

a) to study and investigate the current condition of the farmland which was covered by lahar material along the rivers,

b) to propose the appropriate measures to recover agriculture activities for the river-side lahar covered area,

c) to list up suitable crops for the lahar area with required input ,and

d) to estimate cost of mobilization, annual operation and expected amount of products .

(2) Scope of the Research

The research works include review of existing studies, contact to the related agencies, field investigation, direct interview to farmers, soil quality and groundwater level investigation, plan formulation of alternative plans (including appropriate crops to plan on the area) and the costs and benefits estimation. The procedures / methodologies are as follows:

a) Review of Existing Studies

The research team visited to the following agencies to correct the data related lahar agriculture and exchange opinion / comments regarding the research in the study:

- Department of Agriculture
- Soil Research & Development Center (JICA/DA)
- University of Philippines, Los Banos (Department of Soil Science)

b) Field Investigation / Interview to Farmers

Interview to formers through field investigation was conducted from middle January 2002 for about one month. The area covered is the whole area of the study area and some river-side area in the eastern part of Mount Pinatubo. For the western part, interviews to forty (40) farmers were conducted to clarify the differences in agriculture activities before and after the eruption of Mount Pinatubo. For the eastern part, those ten (10) farmers who have already recovered

agriculture activities on lahar area were visited to get their experiences how to recover the farmland.

c) Soil / groundwater Investigation on Lahar Agriculture Area

Soils from the lahar area were sampled in the course of field investigation. There are twenty-five (25) samples collected from the lahar field in the different river basins and vegetation condition on the area as shown in Figure 3.3.1.

Particularly, soil sampling in the different vegetation condition was well examined to clarify the differences in the soil recovery after the eruption. The number of soil samples in the different vegetation conditions is as follows:

- Cultivated lahar farmland: 8samples
- Lahar area on which the pioneer plants are observed: 12samples
- Lahar area on which no vegetation are observed: 5samples

Based on the above, the different characteristics of soil were examined for proposing appropriate measures for agriculture development.

Groundwater survey was conducted for the fifty (50) locations, which are each two (2) existing wells around the twenty-five (25) soil sample sites. The investigation was conducted only for the groundwater level in the dry season to investigate depth of groundwater level from the surface for the purpose of possibility of pumped irrigation.

d) Formulation of Alternatives / List up Appropriate Crops

Based on the investigation a) through c) above, alternative agriculture development plans were formulated, which basically provides the possible crops for planting in the lahar area in the differences of soil quality recovery condition after the eruption. Major possible crops will be listed under the difference conditions of lahar area and the required input and expected production with income will be estimated.

3.3.2 Previous Studies regarding the Lahar Agriculture

There are various studies previously conducted for agriculture activities on lahar area. The followings are some salient information:

1) Yoshida and Rondal, eds. (DA / Soil Research & Development Center)

The general characteristics of lahar materials are: slightly acid to neutral reaction, low available P, low CEC, low levels of EC, and relatively high contents of sulfate. For agriculture, the high sand and low water holding capacity are the most serious limiting factors. Crops will be difficult to grow without irrigation. Sulfate can be reduced to H_2S in submerged conditions which could injure rice roots.

2) Samonte, et. al. NRCP (1997)

The lahar used (un the experiment) which was obtained from Bacolor, Pampanga had a loamy sand texture, neutral to slightly alkaline reaction (pH7.3) and very low organic matter, CEC, P, and K. It had a low soluble Fe and Mg, high in Zn and Cu, and very high in sulfate. This sulfur content (306.63 ppm) is ten times higher than critical levels and may cause some problems if no decreased by leaching during the growing season.

3) Aganon, C. and Patricio, M.G.. in NRCP (1997)

Soils of this nature (as in lahar) need to be improved physically and chemically in order to provide

source of livelihood to the affected farmers. Increasing the organic matter contents of volcanic deposits is one of the strategies to improve granulation and water holding capacity. Water management and cultivation procedure such as adequate rate and time of application are equally important considerations.

Except mungbean, the rest of the crops (peanut, soybean, sweet potato, sunflower, sesame, radish, rice, squash, tomato, eggplant, okra, onion, corn, cabbage, and sorghum) performed well at certain rates of fertilizer application supplemented with organic fertilizer.

4) DA RFU3 (undated) Status of Agricultural Lands in the Lahar Laden Areas of Central Luzon

In Pampanga, the widely accepted method of rehabilitation is through scraping of the lahar deposition. Also, around 4,000 hectares have been deep-plowed using 10 tractors donated by the Japanese government. Majority of the rehabilitated areas are now used for rice production during the rainy season and for vegetable production during the dry season. Some are utilized for the production of sugarcane, corn, and some root crops. Others are being converted into tilapia fishpond and orchard. Alternative land uses include conversion into industrial / residential zones, as tourist destination and quarried lahar sand used as construction materials.

3.3.3 Soil Condition on Lahar Area

The results of laboratory test is complied in Table 3.3.1 and summarized as follows:

Particle size distribution

Results of the particle size distribution analysis according to present vegetation/land use indicate that the particle size of lahar becomes finer as the deposit becomes older (i.e. deposit becomes stable) and is subjected to cultivate.

In eastern Pinatubo where the lahar deposits are relatively older, the cultivated areas have already developed into loam even up to clay loam. This probably means cultivation has effectively mixed the old soil with the lahar deposits.

In western Pinatubo area, where no plants have been established (an indication that the lahar deposit is fairly new), the texture is still very coarse. Where pioneer plants (mostly talahib and tambo) have established, the texture was finer ranging from coarse and to loam. The texture in cultivated area are similar to those in areas with pioneer plants. This indicates that cultivation in these lahar areas is fairly recent.

In terms of particle size in the lahar deposit area, it is generally concluded that coarse sand, sand and loam is dominant material and the water holding capacity of soil would be insufficient for crop production.

pH

Average pH is 7.00 in the area without plants, while for the areas with pioneer plants and cultivated areas, pH is 5.84 and 5.00 respectively. Considering the favorable pH for crop production which is 5.5 to 8.5, pH generally poses no problems to crop production in lahar areas.

There are, however ,certain areas in western Pinatubo that needs special attention because of potential acidity problems, particularly in downstream Bucao River (San Juan:pH3.5) and in the lower and middle reaches of Santo Tomas River (Rabanes: pH4.3, and Namatacan: pH4.3). The areas in which low pH are recorded locate along the dike on the land side. The condition in these area is rather swampy area.

Organic Matter

Organic matter was generally very low in the study area. The average OM content is only up to 0.96%

which is much below the lower limit of 3.00% that is favorable for crop production. Only one area, in the middle reach of Bucao River (Cultivated area on lahar at Poonbato), had more than 3.0% of OM.

Phosphorus: P

Available phosphorus is generally high in the study area. Considering to marginal lower limit of 4.00 ppm, only two samples were found to have lower available phosphorus. Based on averages, available phosphorus tended to increase as the lahar becomes older and is cultivated.

Potassium: K

Exchangeable Potassium (K) is generally low in the study area. Based on the marginal range of 0.15 to 0.25 cmol(+)/kg soil, two sites in eastern Pinatubo (Sacobia-Bamban downstream and Abacan) and all exept three sites in western Pinatubo (all in Santo Tomas River) had exchangeable potassium lower than the marginal milit.

CEC (Cation Exchange Capacity)

Cation Exchange Capacity is very low. Considering the marginal range of between 10-20 cmol(+)/kg soil, all samples except one (in Santo Tomas River) had lower than the marginal CEC. The results are consistent with earlier analysis of lahar CEC. This low CEC pose a proble particularly when inorganic fertilizers are applied for crop production such that split application or even use of slow release fertilizer is being recommended to avoid the loss of fertilizers through leaching. The over-all low soil fertility being shown by tata, however indicate that build up of organic matter to improve soil structure and probably enhance CEC must be done first before any commercial fertilizer is applied for economic reasons. Micronutrients such as FE and S can be problematic.

Micronutrients

Micronutrients such are Iron and Sulfur can be problematic. Among the microtrients analyzed, Zn and Cu appear to be the least critical in these lahar areas. Zn levels ranged from 1 to 5 ppm while Cu levels were from 2 to 37 ppm. These ranges are well within tolerable limits for crop production.

Iron (Fe), Manganese (Mn) and Sulfate (SO4) will probably be the most problematic for crop production in these lahar areas. Fe levels ranged from 6 to 433 ppm, Mn from 12 to 121 ppm, while SO4 was from 23 to 1,263 ppm.

According to Landon (1984), while Fe toxicity rarely creates probles in the field, absorption of roots of ferrous iron (Fe++) can create problems in rice nutrition. This is probably the reason for Rondal to comment that rice is no longer an option in areas with iron toxicity problems. Incidentally, high levels of Fe (285 ppm) were found only in one area where rice is the present land cover and this is in the lower right side area of the Santo Tomas River.

Sulfate: SO4

Generally, it was found that sulfate (SO_4) is quite high concentration in almost all the soil samples from lahar. Because, the lahar material was produced due to the eruption of Mount Pinatubo, and Sulfur (S) is highly contained in the volcanic material.

It is known that Sulfate (SO_4) may be one of the sources of soil acidity, which might affect to the growing of crops.

Figure 3.3.2 shows the co-relation between the vegetation condition and pH of the 25 soil samples. It shows that the pH of no plant areas is higher than the other area with ranges of 6.4 to 7.9, and is tends to be lower where pioneer plant is observed as 5.7 to 7.3. The cultivated lahar area then became more acid rather than the area on the pioneer plants with valued of 4.3 to 6.9. It seems that the area observed some

plants would be oxidized because of photosynthesis and microorganism activities in the soil, and the chemical action on SO_4 might be in active.

Figure 3.3.3 shows the co-relation between pH and SO_4. The tendency of the relation is that acid lahar is rather high concentration of sulfate, which may be stimulated by the soil chemical activities through the photosynthesis of the plants.

According to the previous research by Soil Research and Development Center DA/JICA, high concentration of sulfate (SO_4) will seriously affect to the paddy production. The wet paddy lahar farm will be less oxygen by water impounding on the land and the deoxidization activities is encouraged in the soil, and then sulfate (SO_4) will react to form H2S, which would act to spoil the paddy. The soil became acid by the reaction of SO_4-H_2S circulation system.

According to Soil Research and Development Center DA/JICA, Iron (Fe) is one of the solution to mitigate the soil acidity caused by sulfate. Mixture of lahar with red clay, which will have high concentration of Fe, will react between SO_4 and Fe and create FeS, which is no more harmful for crop growing.

Figure 3.3.4 shows the co-relation between SO_4 and Fe concentrations of the 25 soil samples. It was found that the areas where no plant is observed tends relatively high-SO_4 and low-Fe concentration, on the other hand, the areas where pioneer or cultivated plant on the lahar area was high-SO_4 and high-Fe soil formation.

3.3.4 Groundwater Level and Quality on Lahar Area

Groundwater Level

There are fifty (50) measurement points of groundwater level in this study. The locations are generally selected adjacent area of 25 soil sample area.

It was found that the groundwater level is very shallow from the land surface, which was generally less than 5m from the land surface, and the average static water level below ground surface is 3.99m.

There were no significant differences in the groundwater level before and after the eruption. Based on the Rapid Assessment of Water Supply Sources in the Province of Zambales conducted by the National Water Resource Board in 1982, the following characteristics of groundwater conditions was reported:

- the average groundwater depth in the province is 3.82m,
- specific capacity ranges from 0.43 liters per second per meter (lps/m) to 1.3 lps/m,
- well discharges range from 0.04 lps to 8.52 lps,
- some pertinent water well data summary for the target municipalities are give below:

Characteristics of groundwater condition

Municipality	Specific Capacity (lps / m)		Well depth (m)		Groundwater Depth (m)	
	Average	Range	Average	Range	Average	Range
Botolan	0.5	0.315-0.757	14.19	7.62-46.34	5.35	1.52-24.39
Cabangan	0.67	0.504-0.757	19.99	8.84-28.90	3.29	1.85-5.18
Castillejos	0.63	0.44-0.94	24.88	11.59-48.17	3.10	0.3-6.1
San Narciso	0.59	0.15-1.26	28.79	10.67-73.17	2.84	0.61-7.62

While these results for ground water level seemingly indicate good water availability as the measurement was conducted during the dry season in February 2003, such data are not sufficient to

determine the potential water supply particularly for agriculture uses. This would need more detail study to stimulate the combination model on the surface water run-off and the ground water flow is required to assess the development potential on groundwater resources.

Water Quality

The former study on the eastern part of Mount Pinatubo is pointed out that the groundwater may be contaminated by high concentration of sulfate. Because, the high concentration of river surface water was observed in the study area, and the groundwater is stored through the river flow or rainfall on lahar covered area through seepage. The observation results of groundwater quality in eastern part of Mount Pinatubo are summarized below:

Comparison of SO_4 Concentration of River / Ground Water in East Pinatubo

River	River Surface Water		Groundwater	
	Upstream SO_4 (ppm)	Downstream SO_4 (ppm)	Upstream SO_4 (ppm)	Downstream SO_4 (ppm)
Bamban	406	210	272	334
Abacan	14	14	230	526
Pasig	270	290	409	979
Gumain	-	34	3	78

Notes: Water sampling on March 1998

Source: Soil Development Research Center DA / JICA

The soil development research center pointed out that the high concentration of sulfate is worried to affect to paddy plantation, by which the acid soil might be created in the paddy field. That might result to decrease of the productivity as well as spoiling the paddy itself. In this point of view, some attentions for paddy farming in the lahar affected area will be required.

The laboratory analysis on the groundwater in the western part is also conducted in the study. The result is compiled in Table 3.3.2 and the location is shown in Figure 3.3.5. Considering the contents of sulfate in groundwater, the concentration of sulfate was compared between the surface and ground waters as follows:

Comparison of SO_4 Concentration of River / Ground Water in West Pinatubo

River	River Surface Water		Groundwater	
	Mid-stream SO_4 (ppm)	Downstream SO_4 (ppm)	Mid-stream SO_4 (ppm)	Downstream SO_4 (ppm)
Bamban	131	262	No sample	33
Abacan	246	No sample	428	34

Notes: Water sampling on river surface water: May 2002 / Water sampling on groundwater: March 2003.

Source: JICA study team

It is generally observed high concentration of river surface water as observed in east Pinatubo. For the ground water however, the high concentration of sulfate is observed only the place adjacent to the river. The samples located in the downstream plain a few kilometers apart from the river channel marked low concentration of sulfate. Though the samples are quite limited and it is still too early to conclude, the affect on soil acidity due to high concentration of sulfate might be less than the eastern part in the downstream plain apart from the lahar affected rivers.

However, it is observed that electric conductivity of the groundwater in the western part is rather high compared with the standard for irrigation water by NIA. The measured EC is between 210 uS/cm and

1,120 uS/cm but the standard by NIA is given 350 uS/cm. Generally, the EC value is applied to measure the chloride concentration for irrigation, but the values of samples are much less than the standard. It means that some other minerals such as Magnesium and Manganese, which are recorded high concentration in the laboratory test, would affect to increase EC value. Therefore, the detail assessment would be required to assess the availability of groundwater for irrigation purposes in the study area.

3.3.5 Interview to Farmers on Lahar Area

The farmers interview was conducted to enable the study team to better understand and appreciate the existing conditions of the agriculture and the farmers in the study area, and design an agriculture-based development plan that is appropriate and tailored-fit to the target communities. The results of the survey and the attendant implications will a very essential and would serve as a guide in formulating the agriculture recovery plan for the study area.

The farmers' interview was conducted for 40 farming families in the study area. In addition, 10 farming families in the eastern part of Mount Pinatubo was also conducted by means of the same questionnaires to compare the differences, which must be also useful to assess the agriculture recovery plan for the study area, to refer the successful experiences in the eastern part if any.

The questionnaires are included the following aspects:

- Personal information,
- Annual family income,
- Ownership of farm and household assets,
- Previous farmland recovery activities and the cost,
- Change of farmland utilization before and after the eruption,
- Livestock and poultry inventory,
- Availability of credit and extension support services,
- Farmers' concerns,

The findings from the interview survey are compiled as follows:

1) More than 70% of the samples in the western Pinatubo belong to less than 30,000 pesos in annual income, which is only 25% of national average income per family. On the eastern side, the ration of less than the 30,000 Pesos was just 40%.

2) The farm size and rice production yield was dramatically decreased after the eruption. The average values are as follows:

Average Value of Farm Size and Rice Production Yield

Items	Western Pinatubo		Eastern Pinatubo	
	Before 1991	Present	Before 1991	Present
Average area cropped (ha)	1.68	1.49	2.28	1.89
Average rice yield (kg / ha)	4,194	1,545	7,544	2,905

3) As shown above, the production yield of paddy field was seriously decreased, only 30% as before the eruption.

4) The eruption and lahar caused a reduction in area now being cultivated and consequently caused shifts in cropping patterns. The shift involved either reduction in number of rice crops per year or addition of other crops either as a sequence to rice or as sole corps.

5) The incidence of lahar damage saw a decline in the use of water pumps and gravity type of irrigation and a consequent increase in farmers' dependence on rainfall.

6) Other crops now being grown aside from rice include vegetables (eggplant, tomato, squash, ampalaya), root crops (sweet potato, cassava, gabi), legumes (sitao, peanut, mungbean), fruits (watermelon), and fruit trees (mango, calamansi, banana, coconut).

7) Only few farmers 85 out of 8 in Eastern Pinatubo, 15 out of 40 in Western Pinatubo) sell their rice produce. Produce from other crops are mainly for home consumption. Apparently, access to and limited market outlets are the major problems related to marketing.

8) Major issues for the farmers in the western Pinatubo were (1) lack of irrigation water, (2) lack of capital, and (3) infertile soil.

9) Regarding the farmers' suggestions on how government or other organizations can improve agricultural production, the major answers were (1) loan programs/availability of credit, (2) irrigation facility, and (3) training on crop/livestock production practices/technologies.

10) For recovery of lahar damaged farms in the study area, the experienced farmers' advised (1) addition of fertilizer/organic matter to lahar-damaged soil. But many of farmers have no good suggestions to improve.

11) Almost all the farmers in the western Pinatubo (39 out of 40) still consider rice as their most preferred crop. This result is not surprising because the rice crop has an important role in meeting the subsistence requirements of the farm household. It has always given the farmers a feeling of food security, rice being the staple food of Pilipino. In fact, in most of the rice-producing areas in the Philippines, growing rice has become a way of life. Moreover, compared to other annual crops, rice is not as labor and capital-intensive, relatively less perishable and market is readily available.

3.3.6 Selection of Appropriate Crops for Lahar Area

In the course of field investigation, it was found that substantial quantities of pyroclastic materials have moved down and the deposits along the river have started to show signs of stability. In face, in some areas investigated by the study team, cultivation has started as early as 1996 or five years after the eruption and that rehabilitation has been going on although slowly ever since. Changes in the physical condition of lahar and establishment of pioneer plants are positive signs that such areas are now ready for agriculture development. Such development, however, as indicated in several studies in lahar agriculture, would necessarily entail some time, effort and costs.

The soil analysis indicates that while the fertility level is very low to support crops, they can be managed and brought back to crop production with the application of technologies that will improve the soil conditions, physically and chemically, and provision of basic needs like water and fertilizer and with properly fitted cropping patterns.

The following crops are accordingly listed up as appropriate crops for production on the lahar area.

Categories	Seasons	Crops	Expenses (Peso/ha)	Revenue (Peso/ha)	Net Income (Peso/ha)	Remarks
Cereals	Wet Season	Rice	21,972	58,800	36,828	
	Dry Season	Corn	26,973	40,670	13,697	
Vegetable	Dry Season	Onion	79,056	375,000	295,944	*1)
	Dry Season	Garlic	102,640	300,000	197,360	
	Dry Season	Tomato	49,429	405,000	355,571	*1)
	Dry Season	Squash	31,056	72,000	40,944	*1)
Fruits	Dry Season	Watermelon	28,042	225,000	196,958	*1)
Legumes	Dry Season	Mungbean	17,566	30,000	12,434	
	Dry Season	Peanut	22,615	50,000	27,385	
Rootcrops	Annual	Sweet Potato	33,741	223,200	189,459	*2)
	Annual	Cassava	48,966	180,000	131,034	*2)
	Annual	Gabi	45,371	225,000	179,629	*2)

Notes: *1) Crops is not appropriate in areas with poor access to market, such as middle stream of Bucao, and upstream of Santo Tomas Area.

*2) Crops are not appropriate in the areas where share tenancy is dominant land tenure.

The labor and material requirements for different production activities and yield data for various annual crops were taken from Aganon et.al. (1995: Crop Production Technologies in Ash and Lahar Laden Areas). The prevailing market prices in Iba, Zambales for seeds, fertilizers, chemicals, diesel and oil were used to determine the material costs while existing wage rates for hired labor were taken from direct interviews and were used to determine labor cost of production operations. The market prices of crops were taken from the Municipal Agriculture Office of Iba, Zambales and were applied in determining the value of total crop yield.

Forage grasses, pasture legumes and possibly fodder trees are not included in the appropriate list above, but they also should be selected as appropriate crops in the area where livestock, particularly cattle and goat, is common. These plants thrive with minimum of water. The leguminous crops will provide basic nitrogen into the soil, which would highly contribute to improve the soil condition. The forage crops will be continued for 7 to 10 years, and they will raise livestock by grazing. The livestock waste will be naturally distributed to the lahar pasture land and it will enhance fertility of the lahar pasture land. This way for lahar agriculture development was also recommended in the eastern Pinatubo area (refer to "Agricultural Development Planning for Sabocia-Bamban River Basin", DPWH / Nippon Koei / PHILKOEI International, March 1998).

3.3.7 Key Issues for Development Plan Formulation

For the plan formulation, it is important that the plan should be reviewed in terms of (1) technical, (2) economical, (3) environmental, and (4) social viewpoints.

In terms of technical viewpoints, the negative effects on high concentration of sulfate in soil and water would be one of the key issues. In addition, to increase Nitrogen (N) in the soil will be important to fertile the soil for agriculture. How to provide more organic matters in the lahar area is another key issue in technical viewpoints?

In terms of economical viewpoints, the marketing issues should be considered for formulation of development plan. According to the farmers' interview and field investigation, many places in the study areas have no good access to market, in which cash crop production such as vegetables and fruits will not be feasible as the income generation measures.

In the environmental viewpoints, it is necessary to take special attention on the irrigation development in such areas as high concentration of sulfate in soil and water. Appropriate cropping pattern should be

well considered taking into account the water and soil quality and considerable negative environmental effects such as soil acidity and so on.

For the groundwater quality, the high Electric Conductivity is required to concern for irrigation development. The EC level is generally considered as the guideline of chloride concentration for paddy production, and the NIA usually measure the EC value to assess chloride concentration. In case of the study area, however, the chloride concentration in groundwater is generally low and much below the limit set by NIA. Accordingly, some other minerals might be caused by high EC level, which is needed for further investigation.

In addition, particularly at the Sto. Tomas River basin, the water quality of the Mapanuepe Lake is rather critical condition for irrigation development. Based on the water quality survey in this study, some heavy metals were detected beyond the standard of irrigation water. The water quality are discussed in Subsection 3.4.3 Water Quality and Appendix-III: Meteorology and Hydrology in this study. For the irrigation development in the Santo Tomas River basin, therefore, further detail assessment on the water quality will be definitely required.

In the sociological viewpoints, it was found that the rice production is the most preferable for the farmers, and there are some difficulties to change crops to cash crops such as vegetable and fruits due to difficulty of access to market. Irrigation development is therefore highly required by the farmers as the improvement measures. On the other hand, there might be some environmental constraints due to water quality in the area as mentioned above. The further detail assessment will be therefore needed to encourage irrigation development as farmers required.

For improvement of productivity on lahar agriculture land, the former research by conducted productivity experiments for paddy and chili (as cash crops) under the different conditions. The results are summarized as follows:

Results on Productivity Research by Basket Farming (Compost)

Soil Condition	Paddy pot (g/pot)	Chili pot (g/pot)
Only Lahar	3	6
Lahar + kitchen garbage(5kg) + red clay (1 kg)	28	**41**
Lahar + kitchen garbage(5kg) + fowl droppings (1kg)	**35**	2
Lahar + kitchen garbage(5kg) + fowl dropping (1kg) + red clay (1kg)	21	18
Lahar + kitchen garbage(5kg) + bio-enzyme (10%) + red clay (1kg)	19	21
Lahar + chemical fertilizer	25	3

Source: Environmental Recovery on the Lahar Affected Areas due to the Eruption of Mount Pinatubo in 1991 (Published in Japan, April 2002, edited by Dr. Masao YOSHIDA and others)

The above result indicates that there are some ways to improve the agriculture productivity through input to the lahar area cultivation. Based on the former research, provision of kitchen garbage and fowl dropping, and red clay will improve the productivity of lahar agriculture land.

3.3.8 Proposed Development Plan for Lahar Agriculture Development

(1) Development Area

The areas for lahar agriculture development are selected as follows:

No.	Place	Barangay	Area	Area condition	Market Access	Land Tenancy	Others
1	Bocao, Middle (Left)	Poonbato	225 ha	Pioneer plant	Poor	None	
2	Bucao, Middle (Left)	Malomboy	31 ha	No Plant	Poor	None	21+10 ha
3	Bucao, D/S-1 (Left)	San Juan	200 ha	Pioneer plant	Good	Full	Acid soil
4	Bucao, D/S-2 (Left)	San Juan	120 ha	No Plant	Good	None	
5	Marella , (Left)	Aglao	300 ha	No Plant	Poor	None	Influensive by Mapanuepe
6	Sto.Tomas, middle (Right)	Santa Fe	600 ha	Pioneer plant	Poor	None	
7	Sto.Tomas, middle (Left)	San Rafael	250 ha	Pioneer plant	Good	None	
	TOTAL		1,726 ha				

The areas where the cultivation activities have already started, such as Maloma, mid-stream of Bucao left side, and Balin-Baquero right side were not selected considered as the target development area.

Location map of lahar agriculture development in the study area is shown in Figure 3.3.6.

(2) Development Plan

The following procedures are required for lahar agriculture development:

1) River training works
2) Land development activities
3) Soil improvement works
4) Fertilizer provision
5) Water supply
6) Cropping and harvesting

Details of each activity are described as follows:

1) River Training Works

As all the proposed area is within high water channel area on which thick lahar is fully covered, river training works is essential prior to the utilization for agriculture activities. The training dike or spur dike should be constructed to separate the flood / mudflow channel from the target development area. For the river training works, the maximum required river channel width was determined based on the 100-year probable flood capacity, although it is not considered in the master plan on the flood and mudflow control. The maximum required river width was then defined as the following formula:

$$14 \times Q_{100} \wedge 0.5$$

Accordingly, the required river width for the Bucao and Sto. Tomas River were determined as 1,100 m for the Bucao, and 800 m for the Sto. Tomas River. It is noted that the provided maximum river width were considered only for development plan formulation for lahar agriculture along the river, and not for the flood and mudflow control works.

For the river training works, the following structures were considered to change / fix the flood

/ mudflow channel:

a) Training Dike / Spur Dike

Training dike / Spur dike is proposed to change the course of flood / mudflow in the river. The gabion made training dike with 5 m height (3 m from the present ground level, and 2 m below the ground level) is proposed to be provided. Top width of training dike is designed as 2 m.

b) Separation Dike

Separation dike is proposed at the confluence of the main stream and the tributaries. The some of proposed development areas, such as Poonbato, Malomboy along the Bocao River are located at the confluence, and channel works for the tributary will be required to utilize the area between the main stream and the tributary.

The separation dike is designed as lahar embankment dike with the slope of 1:2. The surface with 50 cm will be covered by the mountain soil. The boulder riprap will be provided on the slope of the tributary side. The dike height is tentatively designed at 3 m and the top width is designed as 6 m.

The work quantity and cost for the river training works for each development is shown in Table 3.3.3.

2) Land Development Works

Land development for the target lahar agriculture area will be required as the initial development activities. Clearing of pioneer plants, scraping, deep plowing, leveling and establishment of boundaries (foot path) and perimeter fencing are included in this works. The cost for land development is basically for labor cost. The estimated cost for land development per ha is as follows:

Cost Estimation of Land Development Cost

No.	Activity	Cost (Pesos)
1	Scraping	P.6,000/ha
2	Clearing of pioneer plants	P.1,500/ha
3	Deep plowing	P.2,500/ha
4	Leveling	P.1,500/ha
5	Establishment of boundaries	P.5,000/ha
	TOTAL	P.16,500/ha

3) Soil Improvement Works

Prior to cropping activities, soil improvement period by one season are considered. Enriched fallow in addition to application of fertile soil, domestic waste and green manuring using residue of mungbean crop is proposed for no plant as well as pioneer plant area. The cost for soil improvement works are estimated as follows:

Cost Estimation of Soil Improvement

No.	Activity	Cost (Pesos)
1	Green manuring using Mungbean	P.2,000/ha
2	Enriched Fallow + Composting	P.1,500/ha
3	Mixing with imported fertile soil / with red soil	P.1,200/ha
4	Mixing with domestic waste	P.500/ha
	TOTAL	P.5,200/ha

4) Fertilizer Provision

Together with the soil improvement works, fertilizer provision to support crop growing on the poor lahar soil will be definitely required. Full fertilizer provisions for rice and mungbean follwing recommended rate in "Crop Production Technologies in Ash and Lahar Laden Areas" (Aganon, et.al. 1995) are applied. In addition use of coco green organic fertilizer plus inoculant for mungbeans are planned. The cost for fertilizer provision is as follows:

Cost Estimation for Fertilizer Provision

No.	Activity	Cost (Pesos)
1	Commercial Inorganic	
	1, Single (4 bangs)	P.2,080/ha
	2. Complete (8 bags)	P.3,840/ha
2	Commercial Organic	
	1. Chicken Manure (20 bags)	P.2,400/ha
	2. Coco Green (8 bags)	P.1,060/ha
	3. Inoculant	P.60/ha
	TOTAL	P.9,980/ha

5) Water Supply

As the most expected crop of the farmers is identified as paddy, the water supply system is also considered for the lahar agriculture development. Some of the area may be available the river water of the tributary which is not affected by the lahar such as the left side of the Bucao River and right side of Santo Tomas River at Barangay Santa Fe. For the cost estimation of water supply in this case, shallow tube well (40-foot, 4-inch diameter for irrigation up to 5 ha) is considered. For the actual development, however, the water quality of shallow tube well should be assessed and deep well may be required if the water quality is not favorable for irrigation use. The cost of one unit of water supply system (up to 5 ha irrigation) is as follows:

Cost Estimation for Water Supply System (for 5 ha)

No.	Activity	Cost (Pesos)
1	Materials and labor for STW drilling	P.12,000
2.	Pump (Popular brands)	P.4,000
3	Prime Mover (6-8 Hp brand new Japanese diesel engine)	P.42.500
4	Pump-prime mover base	P.1,000
	TOTAL	P.59,500

6) Cropping and Harvesting

Appropriate crops for the lahar area were discussed in the sub-section 3.3.6 in this Appendix. Actual cropping pattern shall be determined by the farmers' cooperative considering the needs of farmers as well as marketing ability. For selection of cropping pattern, it is necessary to be consulted by the agriculture specialists in the municipality and provincial offices. The details of cost, revenue and net income calculation for respective appropriate crop is shown in Table 3.3.4.

3.3.9 Cost and Benefit Estimation

For the cost/benefit analysis, Rice-Mungbean cropping is selected. Because, the rice is the most desired crop by the farmers, and mungbean is favorable to improve the soil condition in long term viewpoint. However, the areas where the access to the market is good condition, the vegetables of rootcrops such as

onion and sweet potato were applied for economic evaluation. The results of cost and benefit estimation is shown in Table 3.3.5 and summarized as follows:

Summary of Cost / Benefit, Economic Evaluation

No.	Location	Barangay	Area (ha)	Project Cost (mil. pesos)	Annual Benefit (mil. pesos)	EIRR	Cropping Pattern
1	Bucao-middle (L)	Poonbato	225	92.5	30.7	3.7%	Rice-bean
2	Bucao-middle (L)	Malomboy	31	77.5	13.2	-0.9%	Cassaba
3	Bucao-d/s-1 (L)	San Juan	200	75.7	203.1	33.3%	Onion
4	Bucao-d/s-2 (L)	San Juan	120	105.8	81.3	11.6%	Sweet potato
5	Marella (R)	Aglao	300	79.1	40.9	7.6%	Rice-bean
6	Sto.Tomas, middle (R)	Santa Fe	600	55.1	81.8	22.5%	Rice-bean
7	Sto.Tomas, middle (L)	San Rafael	250	220.5	253.9	16.9%	Onion

As shown above, the areas where the market accessibility is favorable the higher economic viability is expected. Because, they can produce cash crops such as onion and sweet potato, which are expected higher net income. Considering to the economic viability and needs of agriculture development in the resettlement centers, the priority areas for agriculture development on lahar area are proposed as follows:

Area-4: Bucao Downstream Left side on River Area (Barangay San Juan)

Area-6: Santo Tomas Mid-stream Right side (Barangay Santa Fe)

Area-7: Santo Tomas Mid-stream Left side (Barangay San Rafael)

The general plan for the priority development schemes is shown in Figure 3.3.7. Total project cost for priority development of lahar agriculture is therefore estimated at 457.1 million pesos with total development area of 1,170 ha.

3.4 Community Development in the Mapanuepe Lake Basin

3.4.1 Proposed Development Plan

It was found that the Mapanuepe Lake greatly contributes to mitigate floods to the downstream owing to the flood regulation effects of the lake. The lake basin has a drainage approximately 90 km^2 (34% of the Sto. Tomas River basin). Hydrological analysis revealed that the peak flood discharge at the downstream stretch was reduced by 40% by the regulating effect of Mapanuepe Lake.

In the initial stage of the study, the possibility of the flood regulation effect of the Marella River to divert the flood to the Mapanepe Lake was considered. However, it was not finally adopted in the master plan because of the following reason:

The reservoir capacity of the Mapanuepe Lake is estimated at 30 million m^3. On the other hand, the sediment yield in 2002 from the Marella basin was 16 million m^3. The lake capacity is too small to contain further sediment delivery from the Marella River.

In addition to the above flood control functions, plenty of development aspects are expected for the Mapanuepe Lake area as follows:

1) To utilize as the water source of irrigation development for the downstream left side area of 1,900 ha.
2) To develop as a tourism resort area, which was nominated by the Provincial Government.

3) To develop as fish-culture farm utilizing a part of the lake area.
4) To develop lahar agriculture land on the lahar fan area at confluence of Mapanuepe/Marella Rivers.

The proposed development plan is shown in Figure 3.4.1. For the irrigation development, National Irrigation Administration (NIA) conducted a feasibility study in 1996, and it was concluded that the proposed irrigation development is feasible from of economic and technical viewpoints.

Zambales was defined as the tourism center of the Region III under the regional development master plan of the Region III by NEDA/JICA, as proposed in 1996. Along this line, the tourism development at the Mapanuepe Lake is acceptable based on the regional development strategy. The tourism spots along the lake are selected based on the topographic conditions and accessibility from the existing road.

Lahar agricultural and aqua-cultural development is proposed to improve the livelihood development for the local people. Four communities were completely submerged by the formation of lake. The local people fully lost their residences and farm land. In addition, job opportunities in the area were drastically reduced due to closing of the mining activities. Taking into account the above adverse effects on the communities, the livelihood development in the Mapanuepe Lake area is an important aspect in the regional economic recovery.

In the course of the study, water quality test at the proposed irrigation intake site was conducted, and it was found that the quality was within the acceptable range for irrigation use. However, the water quality of the inflow from the copper mine area to the lake is in question. To promote various developments in the Mapanuepe lake basin, it is therefore essential to conduct a detailed study of water quality.

Regarding the issue of the safety of the dam against failure, DENR commented that the countermeasures should be taken by the owner of the dam. Accordingly, the issue of the dam safety is not taken into account in the following stage of the study.

3.4.2 Major Issues for Mapanuepe Lake Basin Development

For the community/tourism development on the Mapanuepe Lake basin, there are two major issues to be clarified as follows:

1) Water Quality of Mapanuepe Lake
2) Safety Condition of Dizon Mining Dam

In the course of the study, water quality test at the proposed irrigation intake site was conducted, and it was found that the quality was within the acceptable range for irrigation use. However, the water quality of the inflow from the copper mine area to the lake is in question. To promote various developments in the Mapanuepe lake basin, it is therefore essential to conduct a detailed study of water quality.

Regarding the issue of the safety of the dam against failure, DENR commented that the countermeasures should be taken by the owner of the dam. Accordingly, the issue of the dam safety is not taken into account in the following stage of the study.

3.4.3 Water Quality Survey

(1) Sampling Location and Item

A water quality and bottom material survey was conducted in January 2003. The samples were collected at the Dizon Copper Mining Dam reservoir (one location) and the Mapanuepe Lake (four locations) to determine the appropriateness of the Mapanuepe Lake water for irrigation, fish hatchery and recreation use.

The locations of the samples are shown in Figure 3.4.2. At each location, two water quality samples (surface and mid-depth) and one bottom material sample was obtained. The analysis of samples was carried out in a laboratory in Manila. Water samples were analyzed for 28 parameters and the bottom material was analyzed for 16 parameters.

Based on site inspection, there are no large-scale municipal or industrial discharge sources around the Mapanuepe Lake. The Dizon Copper Mining Company dam is located on the eastern side of the Mapanuepe Lake. According to local authorities, the reservoir had been used for storage of mine tailings. Operations were ceased in 1997 and at present, the mine is not in operation.

(2) Comparison to Standard

Table 3.4.1 shows the water quality results with Philippine Class C standards for fishery and Class D standards for irrigation. Table 3.4.2 shows the bottom sediment results.

For the Dizon Dam reservoir, the water quality standards were exceeded for pH, mercury, lead, iron, manganese, fluoride and copper. For the Mapanuepe Lake, standards were exceeded for mercury, lead, manganese, phenols and copper. Although values that exceed standards are very important, three of the results in particular are noteworthy.

First of all, mercury was detected in two samples. The values were approximately two orders of magnitude greater than the Philippine standards. Further, if compared to the more stringent Japanese environmental standard of 0.0005 mg/l, the values would be three orders of magnitude greater. Such levels would be even greater than normal industrial levels. At these levels, one can say that levels are abnormally high and that the Mapanuepe Lake water would be very harmful for fishery and for irrigation.

The second noteworthy value was for manganese. All samples were far greater than the Philippine standard for agriculture/irrigation with three orders of magnitude. The values are about 900 mg/l for the Dizon Dam reservoir and around 300 mg/l for the whole portion of Mapanuepe Lake though the Philippine standard for agriculture and irrigation was limited to 0.2 mg/l. It would be also harmful for fishery though there is no water quality standard for fishery, recreation and industry.

The third noteworthy value was for lead. All samples were greater than the Philippine standard for fishery. The Japanese environmental standard for rivers is 0.01 mg/l and the standard for freshwater fish is 0.001mg/l. For fear of lead poisoning, the Mapanuepe Lake water should not be used for irrigation or fishery without prior treatment.

The fourth noteworthy value was for copper. The Philippine standard for fish is exceeded at seven of the ten values. Compared to the Japanese standard for rice growing, 0.02 mg/l[1], all values are exceeded. Due to the toxicity of copper to fish and to rice, again the Mapanuepe Lake water should not be used without prior treatment.

The pH levels at the Mapanuepe Lake were between 6.02 and 6.65 which would be considered somewhat low. The Dizon Dam pH was measured to be 3-4 and would be considered abnormally low for natural waters. Commonly, a value below 5 would indicate that some external factor is influencing the pH. In this case, the dam tailings would be the major suspect, while the eruption material and natural geology may also has some effect but to a lesser degree. A low pH is significant because it could cause an increase in concentration of metals, as the water would ionize the metal solids contained in the bottom material. This may be part of the reason for the high concentrations of mercury, iron, manganese, zinc, lead and copper.

[1] 'Mizu Syori Binran' (Water Treatment Handbook, in Japanese) , Maruzen Publications.

3.4.4 Conclusions for the Feasibility Study

The laboratory results indicated that seven parameters exceeded Philippine standards for fishery and irrigation at the Dizon Dam and four parameters exceeded in the Mapanuepe Lake. Of the exceeded results, the results for mercury, lead and copper showed cause of concern. Only two samples contained mercury but the values were abnormally high. All samples contained manganese, lead and most of the samples contained copper. Apart from the above three parameters, levels of zinc were found to be high.

Based on the discussion in the preceding sections, it can be said that the sampled area is not typical of that in natural river water, indicated by the relatively low overall value of pH. Since there are no municipal or industrial discharge sources in the area, it can be said that the high values are caused by a combination of the Dizon Copper Mining Dam tailings, the erupted material and the background geology.

Based on the results, it is recommended that the Mapanuepe Lake not be utilized for irrigation, fish hatchery or recreation. The detected results are extremely high for mercury, manganese, lead and copper.

Since the samples were taken only once, and since some inconsistency was noted in the results, it is recommended that additional sampling and laboratory analysis be conducted. It would be preferable to conduct sampling in short regular intervals, say monthly or even bi-weekly, in order to detect any seasonal trends. In addition, it would be desired if the laboratory acquire a measuring device that has a lower detection limit for mercury than that used during the survey.

Another recommendation is that the regular health check for the people resided surround the Mapanuepe Lake shall be conducted. It is worried that heavy metal contained in the water might be accumulated to the human body through the food / water, which may be affected by the water quality. Also the regular examination of fishes and crops in and around the Lake is recommendable.

If the results are verified, and if it is still desired to use the water for irrigation, fish hatchery or recreation, treatment prior to usage would be required. In such cases, chemical treatment such as flocculation or precipitation removal would be required. Such treatment processes are generally expensive and would not be economically justified. Under the financial conditions, it may be preferable to let the concentration values decrease over time.

3.5 Community Road Rehabilitation in Bucao

3.5.1 Needs on Rehabilitation of Community Road

There are 143 barangays affected by the eruption of Mount Pinatubo in 1991 and the followed series of lahar events until now in the province of Zambales. Among them, eight barangays in Botolan municipality, and 4 barangays in San Marcelino municipality were completely buried by the lahar or submerged by the dammed up lake, and all the people in those barangays were forced to resettle on the downstream resettlement centers at the time of eruption.

After 12 years from the eruption, the watershed condition was gradually improved as shown in the Landsat image in Figure 1.1.1. Some of the buried barangays were rehabilitated to develop their communities on the remained slopes of original barangays, but most of them are still in the resettlement centers. The affected people in the resettlement centers are seriously suffered from the lack of livelihood as there is no available farm land in and around resettlement centers.

The JICA study identified that the most severely affected people / barangays by Mount Pinatbo disasters are still not recovered their life for more than 10 years as before the eruption, and the recovery measure

for the buried / submerged barangays are not in priority if economic viability is the only criterion for selecting the project for implementation.

Needs of rehabilitation of community road was identified in the course of PCM Workshop. The problem analysis in the Workshop No.2, targeting to the people in upstream area of the Bacao River, was revealed that the most of the problems identified by the people can be solved or mitigated if the community road is rehabilitated to connect the areas with the town center.

At present, the remote areas without vehicle access from the town center is difficult to be provided social services by the government, such as education medical service, technical assistance for irrigation and forecast management and so on so that there is no way to visit to the areas by the government staff timely.

The community road rehabilitation project is therefore proposed as one of priority project for the most several affected barangays on the upstream of the western Pinatubo river basins. The natural condition of the areas are gradually recovered and many of the resettled people started to return to their original barangays as there is no livelihood in the resettlement centers.

3.5.2 Proposed Community Road Rehabilitation Network

Figure 3.5.1 shows the proposed community road rehabilitation networks. Three routes are identified in the master plan as follows:

(1) Route-A

Community road for the Upper Bucao area is proposed from Sitio Baquilan of Barangay Malomboy to Barangay Nacolcol / Moraza at the foothill of Mount Pinatubo along the Upper Bucao / Balin-Baquero Rivers. Total length of the proposed community road is 48 km. At 16km from the starting point, the Poonbato Bridge crossing over the Upper Bucao River is planned. The bridge existed before the eruption, but it was completely buried in 1991 due to thick deposition of lahar flow after the eruption.

In the plan formulation the section is divided into two parts, one is from Sitio Baquilan to the Poonbato Bridge as Route-A1 for 16 km; another is from Poonbato Bridge to Barangay Nacolcol/Moraza as Route-A2 for 32 km.

There are seven barangays along the community road with the total registered population of 11,079 as the following breakdown:

Seven Barangays along Community Road

No.	Barangay Name	Population
1	Malomboy	3,598
2	Poonbato	2,487
3	Burgos	591
4	Maguisguis	1,437
5	Nacolcol	377
6	Villar	1,977
7	Moraza	612
	TOTAL	11,079

All the residents in the above seven barangays were moved to the resettlement centers after the eruption of Mount Pinatubo. Currently, about 10% of them have permanently returned to their original barangays, and about 50% of them are settled in the resettlement centers but are seeking for the livelihood in the original barangays.

As there is no community road connected from the town center, the communities are accessible only by foot or carabao cart. It takes three hours to Poonbato, five hours to Burgos, eight hours to Maguisguis and Villar, and ten hours to Moraza and Maguisguis during the dry season. The proposed road would make shorter the access time to two-third through Route-A1, and one-third through Routes A1 and A2.

The community road is designed as gravel road of 4 m wide, and additional shoulder width on mountain slope by 2 m to provide passage way even small scale slope failures are occurred.

(2) Route-B

Community road is proposed from the town proper of Barangay Santa Fe on the right bank of middle reach of Santo Tomas River to Sitio Buag of Aeta community. The total length of community road is 14.9 km along the Santa Fe River, which is a tributary of the Sto Tomas River.

There are four pure Aeta communities along the proposed route-B with the total population of about 1,000. There is no vehicle passable road from the town proper of Santa Fe to the Aeta communities, and the Aeta people usually access by walking to the town proper for marketing the mountain products. The followings are the features of four communities along the proposed road, Route-B:

Features of Four Communities along the Proposed Road, Route-B

No.	Name of Aeta community	Nos. of HH	Travel time to town proper
1	Sitio Baluwet	52	90 min.
2	Sitio Banaba	32	120 min.
3	Sitio Buag	20	270 min.
4	Sitio Bacsil	18	180 min.
	TOTAL	132	

The proposed community road can make drastically shorter the travel time by means of jeepney. From town proper of Santa Fe to Sitio Buag, it takes 4.5 hours by foot for 15 km, which can be less than one hour by jeepney or normal truck. Upgrading social services in the remote Aeta communities through construction of the community road Route-B are expected such as establishment of elementary school, periodical medical care, provision of agriculture technology guidance and so on.

The community road is designed as gravel road of 4 m wide. In addition, 2 m should of the mountain slope side is provided to avoid disconnection by the small slope failures. Maximum gradient was set at 10% so that the public vehicles such as jeepney and normal trucks are possible.

(3) Route-C

Community road Route-C is proposed from Sitio Palayan of Barangay San Rafael to Sitio Kahapa of Barangay Aglao in San Marcelino municipality. The total length of community road Route-C is 45 km along the Sto. Tomas River and Mapanuepe Lake. There are three barangays, San Rafael, Aglao and Buhawen and 11 Aeta communities (Sitio) along the Route-C.

The followings are the features of four communities along the proposed road, Route-C:

Features of Four Communities along the Proposed Road, Route-C

No.	Barangay	Population	No.	Aeta Community	Nos. of HH
1	San Rafael	1,523			
			1	Sitio Lawin	78
			2	Sitio Itanglew	42
2	Aglao	2,365			
			3	Sitio Dalanawan	69
			4	Sitio Ibad	33
			5	Sitio Cuartel	36
			6	Sitio Kahapa	20
			7	Sitio Pawen	32
3	Buhawen	2,424			
			8	Sitio Silbang	52
			9	Sitio Lumibao	32
			10	Sitio Camalca	44
			11	Sitio Sayasay	21
	TOTAL	6,312			459

Of the whole section of community road Route-C, the section of 22 km from San Rafael to the Dizon mine tailing dam is trafficable by vehicle. School teachers commute to the center of Barangay Buhawen by chartered jeepney from the town proper of San Marcelino. The remaining section from Dizon Dam to Sitio Kahapa of 23 km is the new route, which pass through Sitio Camalca, Lumibao, Ibad, Cuartel and Kahapa for 165 Aeta families. The present transportation there is generally by means of banca to cross the Mapanuepe Lake, or by foot crossing the Marella River to Barangay Santa Fe.

The community road is designed as gravel road of 4 m wide. In addition, 2 m should of the mountain slope side is provided to avoid disconnection by the small slope failures. Maximum gradient was set at 10% so that the public vehicles such as jeepney and normal trucks can travel.

3.5.3 Feasibility Design for Community Road Development

(1) Design Condition

Preliminary design for community road development is conducted under the following assumptions:

1) Road Width: Travel way width: 4 m
   Total width: 8 m
2) Bridge Width: Travel way width: 4 m
   Total width: 5 m
   (Baquilan Bridge on Route-A1: 9.54 m: DPWH Standard)
3) Maximum vertical gradient: 10%
4) Road surfacing: 200 mm thick gravel surfacing.
5) River cross structures:
   Design flood < 500 m^3/s: Causeway
   Design flood > 500 m^3/s: Bridge
6) Retaining wall: To provide on the mountain slope steeper than 1:1.

(2) Cost Estimate

Cost estimate for community road development was carried out under the following assumptions:

1) Items for const estimation were as follows:

a) Gravel surfacing including earth works,
b) Structural works including bridge and spillway

c) Structural works for retaining wall

2) The unit rates were set for the three items with consideration of adjustment factors based on the existing condition of the road.

3) Cost for Item 1: Gravel surfacing including earth works,

a) Unit Rate (Pesos/km) = Basic Unit Rate (Pesos/km) x Road Factor x Topo. Factor

b) Basic Unit Rate = P434,782 /km (JPY 1,000,000 / km)

c) Road Factor:

i) New road: 1.0

ii) Improvement of vehicle passable road from footpath: 1.0

iii) Improvement of vehicle passable road (W<3.0m) 0.9

iv) Improvement of vehicle passable road (W>3.0m) 0.8

d) Topo. Factor: based on the cross sectional slope.

4) Unit Cost for Item 2: Bridge and Spillway

a) Unit Rate (Pesos/m) = Basic Unit Rate (Pesos/km) x Type Factor x Width factor x Span factor x Road Width

b) Basic Unit Rate = P43,478 /m (JPY 100,000 / m) for unit rate of 30m span, 9.54m width of bridge)

c) Type Factor:

i) Bridge: 1.0

ii) Causeway: 0.5

5) Unit Cost for Item 3: Retaining Wall

a) Unit Rate (Pesos/m) = Basic Unit Rate (Pesos/km) x Topo. Factor

b) Basic Unit Rate = P21,739 /m (JPY 10,000 / m) for 5m height of wall

The project cost for respective route was estimated based on the above assumptions. The results are summarized as follows:

Summary of Cost Estimation for Community Road Development

(Unit: Million Pesos)

No.	Work Item	Route-A1	Route-A2	Route-B	Route-C	Total
	Length	16.0 km	32.0 km	14.9 km	44.9 km	107.8 km
1	Road Improvement	64.9	131.7	56.0	183.0	435.8
2	Bridge	53.4	331.3	23.9	131.5	540.2
3	Causeway	0.0	57.7	6.5	14.1	78.4
4	Retaining Wall	0.0	0.0	0.0	94.5	94.5
5	Total of Civil works	118.3	520.9	86.5	423.2	1,149.0
6	Engineering Service	35.5	156.2	25.9	126.9	344.7
7	Contingency (10%)	15.3	67.7	11.2	55.0	149.3
8	Sub-Total (5+6+7)	169.2	744.9	123.7	605.2	1,643.1
9	Price Escalation (4%)	19.9	87.8	13.9	56.3	178.0
10	Project Cost	189.1	832.7	137.7	661.5	1,821.1

Total project cost for community road development is estimated at 1,821 million pesos, considering the civil work cost, engineering service, physical contingency, and price escalation.

3.5.4 Assessment on the Project Benefit

(1) Direct Benefit to the Target Communities

As the community road network is proposed on the mountain area to connect remote communities, where the population is quite limited and no remarkable economic activities are observed, economic

viability of the community road development is not expected. On the other hand, it will yield a great benefit for the target communities from the sociological viewpoints. Followings are the expected benefit of the proposed project:

1) Elementary schools can be established and operated, as the teachers from the town proper can commute by public service vehicles. Based on this, school-age children may have opportunities to go to elementary school,
2) Periodical medical care service can be provided by the government because of the accessibility by vehicles. Health condition of Aeta people would be improved.
3) Commodity flow between the remote communities and the town proper will be strengthened. Based on this, the volume of the mountain products for marketing will increases and the income level of Aeta people would be improved,
4) Community development activities, such as community-based forest management and slope agriculture land technology development will be encouraged. By this, the livelihood development on the remote Aeta communities might be realized.
5) Peace and Order in the mountain remote community would be improved. The periodical police patrol would be possible through the community road network.
6) Basin management activities would be strengthened through frequent site visit and technical advise by the government staff, which would encourage future basin conservation as well as sediment control activities in the mountain area. As the results, sediment yield in the basin would be mitigated and the downstream maintenance of river facilities would be lessen.

There would be many other benefits by the development of community road network. On the other hand, it is quite difficult to quantify monetary value on the above benefit.

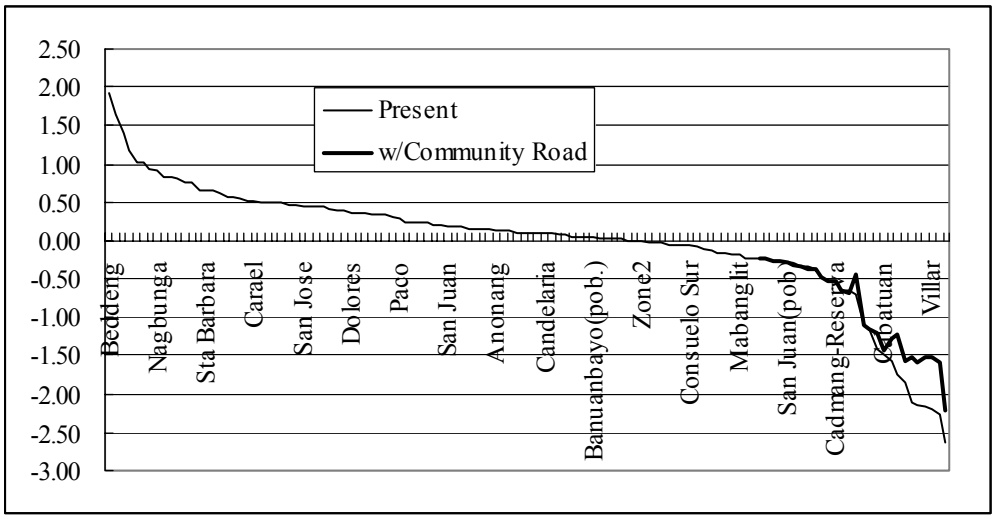
(2) Equitable Development Effects through Poverty Reduction

Another view of the benefit is assessed through poverty analysis mentioned in the section 2.3 in this Appendix. The all the target barangays under the community road development were generally low ranked based on the barangay comparative study. The community road development would contribute to improve some principal factors such as degree of urbanization (PC4) and degree of social infrastructures (PC5). Mitigation of poverty value is therefore reviewed for the target barangays if the community road network is realized. The results are as follows:

Effects on Poverty Reduction through Community Road Development

No.	Municipality	Barangay	Barangay Ranking	Poverty Value w/o Project	Ranking after Community Road	Poverty Value after Community Road
1	Botolan	Maguisguis	122	-2.62	121	-2.23
2	Botolan	Moraza	121	-2.27	115	-1.59
3	Botolan	Villar	120	-2.20	114	-1.51
4	Botolan	Poonbato	119	-2.18	114	-1.51
5	Botolan	Palis	118	-2.14	115	-1.60
6	Botolan	Nacolcol	117	-2.11	114	-1.52
7	Botolan	Belbel	116	-1.84	114	-1.55
8	Botolan	Burgos	115	-1.74	112	-1.23
9	Botolan	Owaog-Nebloc	114	-1.55	113	-1.27
10	Botolan	Cabatuan	113	-1.49	112	-1.44
11	S-Marcelino	Santa Fe	112	-1.41	112	-1.21
12	S-Marcelino	Aglao	111	-1.15	112	-1.15
13	S-Marcelino	Buhawen	110	-1.10	114	-1.11
14	Botolan	Malomboy	109	-0.70	104	-0.46
15	S-Marcelino	San Rafael	95	-0.23	95	-0.23
	TOTAL					

Poverty Reduction Effect by Community Road Development



The result is almost the same as the one by Community-Based Forest Management, that the proposed community road development would contribute to the improvement at the relatively poor barangays in the study area. That would improve the balance of the development in the study area in the view of equitable benefit to the whole area.

3.5.5 Priority Route for Community Road Development

Among the three routes of proposed community road development, it is proposed that the following routes shall be given priority for the development:

1) Route-A1: Sitio Baquilan – Poonbato Bridge site (Bucao River): L=16.0 km

2) Route-B : Santa Fe town proper – Sitio Buag (Santa Fe River): L=14.9 km

For the Route-A-1 and A-2, the beneficial barangays are the basically same, which would be all barangays in the upstream of the Bucao River basin. Route-A1 is to extend from the end of the existing road for 16 km to upstream, by which the access time from the target barangays to the town proper of Botolan municipalities would be much decreased with more or less 3 hours. As the construction cost of Poonbato Bridge is rather expensive, which shares about 50% of the civil work cost of Route-A, it is recommended to develop the downstream from the Poonbato Bridge as the first step.

For Route-B, there will be no big structures required to develop the vehicle passable community road. The area is highly expected for the development of Community-based forest management, and the improvement of the accessibility to the forest site would enhance the effects of the project. Accordingly, it is proposed that the Route-B shall be included in the priority route for the community road development.

For Route-C, the section from San Rafael to Dizon Dam with 22 km is currently passable by vehicle, and no remarkable benefit is expected along the communities between San Rafael and Buhawen. The communities between Dizon dams to Sitio Kahapa, the people generally takes shortcut access across the Marella River to Santa Fe, when they visit to the town proper of San Marcelino, which would be much shorter distance than a proposed Route-C. Also the people living around the Mapanuepe Lake usually use banca to travel to the town proper. Considering the current way the people are taking, Route-C would be less effective for the people. Therefore, the route-C is recommended not to include the priority route for development.

The project cost for priority development is therefore estimated at 326.8 million pesos.

3.6 Establishment of Aeta Assistance Station

3.6.1 Background of the Project

Throughout the additional investigation for the CDPP, it was found that Aeta people are the most affected people due to the series of the disasters related to the eruption of Mount Pinatubo, and they are still suffering from the aftereffects. In fact, the damages to Aeta communities were not limited to their livelihood sources, but to affect their tradition and cultures as they have lost everything as they were forced to leave from Mount Pinatubo, their ancestral territory.

It is said the Aeta people are the aborigines in the Philippines, settled on about twenty five thousand years ago from Borneo island to Luzon. They were originally hunting tribe in the mountain, but changed to agriculture tribe through slash-and-burn farming, and moving in the mountain area. Mount Pinatubo was defined as a holy place for Aeta People for several thousand years.

On the other hand, the proposed structural measures for the further disaster prevention measures are mainly for the lowland and coastal area to protect the existing assets and economic activities against the further disasters. To protect on upland area by the structural measures in fact may not be feasible due to less assets and economic activities to meet the investment.

Even for the proposed non-structural measures, the system would not be effective as the target communities and people are suffering from the poverty, which must be the first to access as the disaster mitigation measures. The effective non-structural disaster management is only possible if the people's organization is self-standing in economic / financial aspects with a long- term vision.

This was also raised in the workshop No.4 from the leader of Aeta Communities, and they proposed to mobilize "Integrated Development Plan for Aeta Community" in addition to the proposed flood and mudflow control plan as the recovery measures in the upstream mountain area.

The study area is known as the territory of Aeta People, particularly around the foothill of Mount Pinatubo on the western side. There are 62,000 Area people in the province of Zambales, of which 53,037 people live in the study area. The Aeta population in the study area is summarized as follows:

Estimated Population of Aeta People in The Study Area

No.	Municipality	Settlement in Mountain		Resettlement Centers (RC)		Total Population
		Nos. of Sitio	Population	Nos. of RC	Population	
1	Castillejos	2	828	0	0	828
2	San Marcelino	22	19,744	0	0	19,744
3	San Antonio	1	90	0	0	90
4	San Felipe	4	1,951	2	642	2,593
5	Cabangan	7	4,620	0	0	4,620
6	Botolan	16	9,242	3	15,920	25,162
	TOTAL	52	36,475	5	16,562	53,037

Source: Barangay Officials & Tribal Chieftains Records (As of March 2001)

3.6.2 Problems and Issues

PCM workshop focusing on pure Aeta people was conducted on 1st February 2003. In this workshop, 56 pure Aeta people attended to workshop to identify the problems and issues and to discuss the solutions.

The participants were ground into five for the small group workshops. They were ground based on issues they will tackle during the actual workshop. A group was composed of the representatives from the LGUs and the issue they tacked was on governance. Another group tacked the issues of indigenous peoples while the three remaining groups tackled social services, livelihood and disaster/flood respectively. The details were described in the former sub-section 2.2.4 in this report.

The following issues are identified as the major problems and issues for the Aeta People in the study area:

1) No livelihood source in the mountain area,
2) No agriculture land is available in the community, which were covered by lahar,
3) Difficult in protection and management of ancestral lands through community farming method of Aeta people
4) Lack of mutual understanding between low land people and Aeta people for their culture and history.

3.6.3 Project Formulation

The discussion with Foundation For Cultural Survival, Inc.(FOCUS), one of the reputed NGO in the Philippines to support Aeta community, was conducted in the course of the study. During the discussion of Mount Pinatubo as an Aeta Cultural heritage, just like the Rice terraces of Ifugao tribe in Banawe of North Luzon was declared as one of the World heritage. This aim to spark Aeta culture and tradition, strengthen their cultural pride and promote national identity while promoting stronger relationships with other cultures.

Importance in the master plan formulation in this study is whether integrated support program for Aeta community should be included in the flood and mudflow control projects or not. The answer is no, but a question is raised why the most severely affected people by series of disasters were left for the master plan formulation for disaster management?

As the results, the study team is concluded that the establishment of Aeta Assistance Station, called as AETAS, is strongly recommended with the multiple functions as listed below:

1) **To establish Aeta Museum for dissemination of their Culture and Tradition to public:** The most important thing is to strengthen the communication between the Aeta community and the lowland people for mutual understanding. In this regard, Aeta museum should be established in AETAS to preserve the cultural heritage of Aera tribe, and for public dissemination of Aeta culture and tradition, which can be recognized as a new tourism spot of Zambales to identify as the base station to access to Aeta Heritage. The income of the museum can be allocated for the sustainable operation of AETAS.
2) **To establish small-scale financing for NGOs activities:** Various NGOs, including the Japanese NGO such as ACTION as well as IKGS, are supporting Aeta community mainly for their livelihood development. Also there would be plenty of people in the world who are willing to assist Aeta people through financial support for their improvement. The AETAS is expected as the hub of the NGOs network related to support activities for Aeta community. Strong linkage between NGOs as well as the individual people would be effective to integrate support to Aeta community. AETAS is expected as the information station for the related NGOs and the financial sources for the various activities with a certain appropriate interest for sustainable operation of financing functions to NGOs as well as Aeta Community Organization.

3) **To provide technical support for Agriculture and Agro-Forestry to Aeta Community:** AETAS is expected to the hub of technical information to link between Aeta communities and Government Agency particularly the Department of Agriculture, Department of Environment and Natural Resources, and Department of Agrarian Reform. AETAS should have the function to arrange the communication based on the request from the Aeta Community to provide the necessary technical information and support. Periodical seminars targeting the Aeta farmers are expected to introduce the effective agriculture and agro-forestry technologies.

   In the aspect, the FOCUS proposed to establish School of Upland Entrepreneurship in Zambales, which will be upgraded existing Aeta Farm School. The 5-month training course would be developed as the joint project with the Ramon Magsaysay Technology University(RMTU), Department of Agriculture (DA), Provincial and Municipal Offices, Agricultural Training Institute (ATI), Department of Science and Technology (DOST) and Bahay-Kubo. The proposed program is based on the following four premises:

   a) 96% of Aetas, particularly tose being served by the Aeta Development Association, project partner of FOCUS in 19 communities in southern Zambales, are upland farmers,

   b) Upland farming can be undertaken as a "business enterprise". This type of farming, unlike lowland farming which is devoted mainly to rice production, offers more productive options: one can raise vegetables, field grains, rootcrops, fruit trees, and fuel trees,

   c) As Aetas are awarded titles to their ancestral land as mandated by the IPRA law of 1997, they must establish sustainable development plan and undertake effective management of its resources,

4) **To educate Aeta teachers:** Formulation of Aeta education system is quite important to preserve culture and tradition of Aeta tribe. This should be integral to the culture. The program should include the necessary issue as the standard education curriculum in the Philippines, but not limited to that. The additional curriculum to put Aeta culture and tradition should be included through their own language. Training to the volunteer teachers from Aeta community shall be recruitment to educate as Aeta teachers to return their original communities.

5) **To assist the claim for ancestral domain:** AETAS is also expected to assist for the process for the survey/documentation/and titling of the ancestral domain claims by the Aeta communities. There are so many difficulties to satisfy the existing processed for the Aeta people.

6) **To perform Aeta Culture Show:** For dissemination and the study on the Aeta tradition, periodical Aeta Culture show shall be performed under the coordination of AETAS, which can be great resources of income generation for Aeta communities for the tourism aspects. The traditional festivals, dances, and singing would be performed as the tourism spot. Volunteer Aeta people will be recruitment for actors/actress and the show program will be formulated by AETAS together with the Aeta people.

7) **To facilitate eco-tourism tour desk:** Those who are interested to experience the traditional life of Aeta community, eco-tourism program shall be provided. The base camp will be AETAS, from which the mountain tour by Carabao Carts will be arranged for tourists. The various wild-lives such as wild-pig and goat will be tasted in the lahar area. The natural hot-springs, dammed-up lakes can be visited through Carabao tours. Volunteer Aeta people will work as tour guide, which would be attractive income source for the Aeta people.

3.6.4 Project Implementation by NGO

For the implementation of assistance activities for Aeta Tribe, the discussion with the related NGOs, as well as NCIP (National Commission on Indigenous People) was conducted. Foundation of Cultural Survival Inc. (FOCUS), NGO in Philippines particularly to support indigenous people, is a partner of the study team to assess the matters of Aeta Tribe affected by the disasters related to the eruption of Mount Pinatubo.

It is recommended that the implementation of AETAS is to be under the leadership of NGO, and the government and donor agencies is to support the activities for the NGOs in terms of technical and financial aspects, because of the following reasons:

1) Various activities for supporting Aeta People in the study area are found which are basically operated by the NGOs. Many of them, however, are limited activities because of insufficiency of available fund as well as lack of technical know-how,
2) In the Aeta communities in the mountain remote areas, some NGO volunteers stayed for long-term and their activities are effective to support Aeta community. Because of long-term relationship between the Aeta community and the NGOs, the Aeta people highly respect / appreciate the volunteers from the NGOs. Based on the existing relationship between the Aeta community and the NGOs, they are the right person to act based on their own program.

In the course of the study, a proposal from the FOCUS was submitted to the study team for assisting their program, which is quite similar to the proposed AETAS by the study team. With the frequent discussion with FOCUS, it is recommended that the FOCUS AETA Project shall be defined as the first step for establishment of AETAS (AETAS, Phase-1) to recover and preserve the cultural heritage of Aeta Tribe in Mount Pinatubo.

3.6.5 Details of the Project

The components of AETAS Phase-1 are as follows:

1) Improvement of Upland Entrepreneurship School of Aeta
2) Ancestral Land Protection, Development and Management Activities,
3) Detail Study for establishment of Aeta Cultural Heritage (AETAS)
4) Aeta Health, Nutrition and Livelihood Program.

The details are shown in Figure 3.6.1 and described as follows:

1) Improvement of Upland Entrepreneurship School of Aeta

The proposed Upland Entrepreneurship School is started as Aeta Farm School, this 5-month training course is a joint project with the Ramon Magsaysay Technological University (RMTU), Department of Agriculture (DA), Provincial and Municipal Offices, Agricultural Training Institute (ATI), Department of Science and Technology (DOST) and Bahay-Kubo. The main objective of the school is to transfer Slope Agriculture Land Technologies (SALT) to the Aeta Student, and to increase their farm income by 50% after 3 years.

Improvement and operation of Upland Entrepreneurship School is estimated about 2 million pesos.

2) Ancestral Land Protection, Development and Management Activities,

Security of habitat is a crucial factor in the life and cultural survival of Aetas. As a land-based people they derived their principal source of subsistence from their environmental and its resources. As for the Pinatubo Aetas, they find security and a sense of belonging to the land of their ancestors.

But the hold of Aetas on their land has always been tenuous. The ever-increasing pressure of lowland

population on upland areas has resulted in considerable loss of Aeta land to outsiders. Now, with the passage of R.A.8371, otherwise known as the Indigenous People's Right Act, which recognizes the rights of indigenous people to their ancestral land, the prospect of ensuring secure habitat has gained a new momentum. But the full implementation of the law is painstakingly slow and in many cases obstructed.

However, the acquisition of ancestral land title by itself is not enough. Equally important is the need to set up of sustainable development and management plans and to undertake training in management and leadership skills to ensure that the resources of their domain are fully utilized for their benefits and protected for future generation. This where NGO's such as FOCUS can play significant roles in bringing their experience, resources, and commitment to complement government efforts, or in many cases, to initiate the necessary action to get the process going.

Activities under this program are then as follows:

a) To obtain a CADT for the 5,000 ha, Negrito Reservation in San Marcelino by year 2005 in cooperation with NCIP,
b) To develop a 200 ha reforestation in order to prevent further erosion of reservation land and to restore its ecological balance,
c) To establish a 2 ha herbal plantation in Baliwet in partnership with ACTION (Japanese NGO),
d) To develop a 1 ha expansion of the mango plantation in Kanaynayan.

The cost for this activity is estimated at 10 million pesos for 5 years.

3) Detailed Study for establishment of Aeta Cultural Heritage (AETAS)

The culture of the Aetas constitutes part of the rich and colorful mosaic of the Philippine culture. It is a product of hundreds and thousand of years of adaptation and thus represents a unique living record of the human experience. The loss of such a culture due to the impact of modernizing changes constitutes a loss in cultural heritage of the Philippines.

As the original inhabitants of the Philippine Archipelago, the Aetas deserve a better understanding and appreciation of their unique culture. That they have managed to live well in relative isolation in difficult environment for thousand of years must say something about their strategy for survival from which something can be learnt. It is for this purpose that the promotion of Aeta cultural heritage takes on relevance.

The objective of the program is to spark the revival of Aeta cultural heritage by establishing an "AETAS" in Zambales over the next 5 years to showcase Aeta life and culture, through cultural performances, festivals, and library of living tradition.

The details study and investigation will be included in this program. The estimated cost for study is at 1 million pesos.

4) Aeta Health, Nutrition and Livelihood Program.

The issue of health and sickness is a paramount concern among Aetas given their geographical isolation and distance from the government health facilities. Infant mortality rate is high and so is malnutrition among Aeta children. This is due in large part to food inadequacy and a shift in diet from traditional root crop-based staple food to rice which they cannot raise in sufficient quantities. Rice is always in short supply. They sell their farm produce to buy rice in the town market.

At the Kanaynayan Aeta Resettlement in Castillejos, Zambales, the HOPE Foundation international had established the first Aeta Hospital in the country. This has become the base of operation of their yearly HOPE medical mission covering nearly all Aeta communities in Zambales. The Kanyanayan Health

Center is the base of operation of the FOCUS Health, Nutrition, and Livelihood Project. Its program will focus on health education among nursing mothers and school children. It seeks to promote the use of herbal medicines which is an integral part of their indigenous knowledge. A livelihood program is integrated into the project to provide opportunities for income generation among the resettlement Aetas. The cost estimated to implement this program is about 15 million pesos.

Tables

Table 2.1.1 Results of Household Interview

No.	Item	Botolan	Cabangan	Castillejos	Iba	San Antonio	San Felipe	San Marcelino	San Narciso
1	Total Population	46,602	18,848	33,108	34,678	28,248	17,702	25,440	23,522
2	Nos of HH in Municipality	9,629	4,032	7,238	7,260	6,483	4,094	5,866	5,319
3	Average nos of persons in HH	4.84	4.67	4.57	4.78	4.36	4.32	4.34	4.42
4	Sample No. of HH	40	40	34	30	40	40	40	40
5	Sampled Barangay	Nacolcol Porac Carael Poonbato Maguiguis Paudpod San Juan Malomboy	Sto Nino San Rafael Nue San Juan San Isidro Del Carmen Apo-apo Cadmang Arew	Buenavista Nagbunga Del Pilar Nagbayan Balaybay Looc San Pablo	Dirita Lipay-dingin Amungan Sta.barbara San Agustin Palanginan	San Nicolas San Gregorio Santiago San Miguel San Juan East Dirita West Dirita Antipolo	Rosete Feria Apostol Manglicmot Amagna Maloma Sto Nino San Rafael	Buhawen Laoag San Rafael Lucero Rabanes Sta.Fe Nagbunga Aglao	Grullo Alusiis La Paz San Rafael Dallipawen Namatacan Libertad San Pascual
6	Housing Condition								
	1) Type-1 Steel & Concrete	27	4	18	12	31	21	18	11
	2) Type-2 Bricks, stone & steel	2	3	3	0	3	0	0	8
	3) Type 3 Wood & asbestos	0	0	0	0	1	1	0	7
	4) Type 4 Cogon, nipa and	9	5	6	4	3	4	11	10
	5) Others Wood/concrete	2	28	2	14	2	10	11	3
	6) No Response	0	0	0	0	0	4	0	1
		40	40	29	30	40	40	40	40
7	Actual Monthly Income								
	1) 0-3,000 Pesos	31	30	18	19	20	27	27	6
	2) 3,000 - 6,000 Pesos	3	9	6	7	10	7	10	22
	3) 6,000 - 10,000 Pesos	3	1	9	1	3	1	1	9
	4) 10,000 Pesos above	2	0	0	3	3	1	2	3
	5) No Response	0	0	1	0	4	4	0	0
		39	40	34	30	40	40	40	40
8	Needed Monthly Income								
	1) 1,000 - 5,000 Pesos	16	13	2	13	10	14	8	3
	2) 5,000-10,000 Pesos	22	20	15	8	20	18	22	28
	3) 10,000 Pesos above	2	7	15	9	6	6	9	9
	4) No Repsonse	0	0	2	0	4	2	1	0
		40	40	34	30	40	40	40	40
9	Souce of Income	Small business Farming Fishing Hired Labor Vending	Farming Vending Small business Livestock raising Honorarium	Honorarium Farming Hired Labor Pension Vending	Honorarium Hired Labor Pension Fishing Farming	Student Housewife Farning Vending Small business	Hired Labor Farming Small business Pension Fishing	Honorarium Hired Labor Vending Farming Livestock	Farming Vending Small business Livestock Honorarium
10	Total damage amount per HH after Eruption								
	1) 50,000 pesos below	47.5%	40.0%	52.9%	76.7%	25.0%	60.0%	55.0%	35.0%
	2) 50,000 - 100,000 Pesos	22.5%	5.0%	14.7%	6.7%	5.0%	7.5%	12.5%	22.5%
	3) 100,000 Pesos above	17.5%	0.0%	14.7%	6.7%	2.5%	12.5%	20.0%	42.5%
	4) No Response	12.5%	55.0%	17.6%	10.0%	67.5%	20.0%	12.5%	0.0%
11	Investment for Rehabilitation including self financing								
	1) 50,000 Pesos below	77.5%	90.0%	2.9%	76.7%	2.5%	40.0%	70.0%	62.5%
	2) 50,000 Pesos above	17.5%	2.5%	0.0%	3.3%	0.0%	2.5%	7.5%	35.0%
	3) No response	5.0%	7.5%	97.1%	20.0%	97.5%	57.5%	22.5%	2.5%
12	Major Changes in living conditions before /after Eruption								
	1) Relocation	17.5%	2.5%	2.9%	90.0%	30.0%	0.0%	20.0%	2.5%
	2) No accece to Bus Terminal	70.0%	95.0%	50.0%	76.7%	95.0%	77.5%	85.0%	40.0%
	3) No access to School	15.0%	5.0%	97.1%	23.3%	37.5%	15.0%	22.5%	7.5%
	4) More available PUVs	92.5%	75.0%	100.0%	36.7%	92.5%	87.5%	75.0%	97.5%
13	Current Condition of Evacuation Activities								
	1) Necessity of Evacuation System	100.0%	97.5%	100.0%	93.3%	90.0%	97.5%	92.5%	85.0%
	2) Presence of Organization for Evacuation	90.0%	82.5%	67.6%	26.7%	57.5%	40.0%	55.0%	100.0%
	3) Experiences in training	55.0%	62.5%	44.1%	20.0%	52.5%	27.5%	42.5%	92.5%
	4) Availability of places to	32.5% WLAC (Bucao) Taugtog RC Baquilan RC Mountains New Taugtog RC	62.5% Pavilion Evacuation Day-care center w/in barangay Mt.Mabiga New San Juan	32.4% Balaybay RC Manila Mountains	56.7% Libis school Tent city Palauig Evacuation Relatives	35.0%	35.0% Amagna Bantay Carmen School Tektek RC	32.5% San Narciso school plaza mountain "lanipan"	35.0% Lalek Sindol Manila Pangasinan Laguna
14	Priority issues to improve the living condition in the Community	①Livelihoon ②Drainage network ③Road network ④Irrigation network ⑤House renovation	①Dike constructuin ②Creek & river ③Elevating road ④Livelihood ⑤Good leadership	①Widening / Ripraping River ②Livelihood ③Drainage ④Road Improvement ⑤Garbage Collection	①Livelihood ②Drainage ③School ④Water system ⑤Health Center	①Drainage ②Livelihood ③Irrigation ④Road ⑤riprap riverbank	①Drainage ②Livelihood ③Road improvement ④Health center ⑤House renovation	①Electricity ②Infrastructure ③Scholarship ④Livelihood ⑤Food	①Livelihood ②Irrigation ③Drainage ④Lending projects ⑤Scholarship
15	Priority Measures for Community Improvement	①Flood control ②River widening ③River dredging ④Dike improvement ⑤Road network	①Flood control ②Dike strenthen ③By-pass channel ④Water spillway ⑤Catch basin for river	①River dredging ②Riprapping ③By-pass channel ④River rehabilitation	①River widening ②Government aid ③Boat for emergency ④Drainage ⑤Elevate Road	①Drainage ②Irrigation ③Tree planting ④Resettlement center ⑤River dredging	①Drainage ②Livelihood ③Road improvement ④Health center ⑤House renovation	①Water channel ②Reforest watershed ③Road improvement ④Drainage ⑤River dredging	①Drainage ②Public consultation ③Clean & clear dikes, canal ④Locate areas greatly affected ⑤Cooperation
16	Priority measures for HH	①Livelihood ②Coordination network ③Early warnings ④Elevate settlement ⑤Relocation	①Evacuation center ②Health Center ③Drainage	①Riprapping ②Maintain cleanliness ③Relocation ④River rehabilitation	①Warning system ②Seminars ③Relocate fishponds ④Relocate people ⑤Livelihood	①Backyard cleaning ②Sandbagging & filling ③Clean canals & road ④Livelihood ⑤Skill training	①Relocation ②Livelihood ③Housing ④Capital (money) ⑤Early warning	①Scholarship ②Drainage ③Resettlement ④Livelihood ⑤Communication	①Public awaredness ②Cooperation with Projects ③Public consultation ④Ensure safety & security
17	Willingness to relocate to the safer places	100.0%	100.0%	94.1%	93.3%	80.0%	95.0%	100.0%	100.0%
18	Desired destination of relocation	45.0% WLAC (Bucao) Taugtog RC New Taugtog RC Baquilan RC Original Barangay	45.0% Sindol Manila Pangasinan Lguna Olongapo	67.6% Subic Castillejos Balaybay Looc Lucena	16.7% within Barangay with relatives	22.5% Barangay hall Mountain School Church Manila	15.0% Amagna Cabaruan RC Lalek RC Bantay Carmen Tektek	27.5% San Narciso Plaza School Buhawen Vega hill	17.5% Sindol Manila Pangasinan Laguna Olongapo

Table 2.3.1 Results of Barangay Ranking Study

Serial No.	Municipality Name	Barangay Name	Topographic Accessiblity	Suitability on Agriculture	Degree of urbanization	Per capita infra. Availability	Availability of education facility	Per capita IRA	Total	Ranking	Cluster
1	Botolan	Bancal	1.277	0.693	-1.398	-0.448	0.196	-0.353	0.337	40	1
2	Botolan	Bangan	-0.669	-0.744	-0.265	-2.696	-1.265	1.002	-0.666	108	5
3	Botolan	Batonlapoc	0.829	1.010	-0.891	0.104	0.212	-0.757	0.364	37	7
4	Botolan	Belbel	-4.759	-1.763	-1.241	1.339	0.766	-1.267	-1.838	116	2
5	Botolan	Beneg	1.441	0.262	-0.553	-0.814	0.566	-0.528	0.360	38	2
6	Botolan	Binuclutan	-1.675	-0.116	0.152	0.340	0.738	0.852	-0.371	103	5
7	Botolan	Burgos	-4.178	-1.864	-1.810	1.286	0.860	-0.819	-1.729	115	3
8	Botolan	Cabatuan	-3.972	-1.569	-1.090	1.256	1.226	-0.659	-1.488	113	1
9	Botolan	Capayawan	1.348	0.066	-1.335	-0.555	0.430	-0.240	0.229	46	1
10	Botolan	Carael	0.522	1.231	0.416	-0.150	0.489	0.076	0.513	22	4
11	Botolan	Danacbunga	0.399	0.906	0.742	-0.549	0.674	-0.095	0.405	33	2
12	Botolan	Maguisguis	-6.267	-1.631	-0.493	-0.939	-3.039	-1.259	-2.623	122	3
13	Botolan	Malomboy	-3.344	0.116	1.753	0.347	1.404	-1.474	-0.707	109	3
14	Botolan	Mambog	-1.817	0.768	0.389	1.299	1.095	-1.119	-0.178	91	2
15	Botolan	Moraza	-5.632	-2.003	-1.447	1.429	-0.433	-1.519	-2.260	121	2
16	Botolan	Nacolcol	-4.332	-2.183	-2.076	-0.483	-2.381	2.034	-2.099	117	2
17	Botolan	Owaog-Nebloc	-3.796	-2.058	-2.227	2.164	0.799	0.858	-1.545	114	4
18	Botolan	Paco	1.577	-0.842	0.787	-0.848	0.577	-0.798	0.269	43	1
19	Botolan	Palis	-5.044	-2.415	-2.646	2.232	0.353	-0.422	-2.134	118	4
20	Botolan	Panan	-2.638	-0.304	1.059	-0.183	0.636	0.603	-0.662	107	1
21	Botolan	Parel	0.688	0.014	-1.180	-0.047	0.897	-0.218	0.120	59	1
22	Botolan	Paudpod	1.332	1.975	-1.334	1.432	-0.471	0.629	0.834	9	1
23	Botolan	Poonbato	-5.420	-1.193	0.858	-2.125	-3.345	-0.089	-2.185	119	4
24	Botolan	Porac	-1.677	0.323	1.515	0.009	0.891	0.679	-0.146	88	1
25	Botolan	San Isidro	1.169	0.593	-0.652	-0.503	0.579	-0.169	0.395	34	1
26	Botolan	San Juan	-2.717	0.739	1.951	0.894	0.118	0.663	-0.279	98	1
27	Botolan	San Miguel	0.758	0.613	-1.907	-1.964	-1.982	-0.202	-0.163	90	3
28	Botolan	Santiago	1.208	1.877	-0.238	0.021	0.144	-0.683	0.743	13	2
29	Botolan	Tampo	1.542	0.900	-1.118	-0.493	0.333	-0.481	0.492	25	1
30	Botolan	Taugtog	-1.842	0.957	3.814	-0.260	1.376	0.836	0.228	47	1
31	Botolan	Villar	-6.023	-1.609	-0.151	0.974	-0.137	-2.390	-2.205	120	4
32	San Felipe	Amagna	0.963	-0.269	1.309	0.214	0.587	0.614	0.453	28	2
33	San Felipe	Apostol	0.580	3.199	1.256	1.528	-0.560	0.201	1.167	4	6
34	San Felipe	Balincaguing	0.928	0.740	-0.699	0.106	0.488	0.453	0.435	31	6
35	San Felipe	Faranal	-0.911	-0.453	0.463	-0.596	1.226	0.563	-0.257	97	2
36	San Felipe	Feria	-1.391	-0.026	-0.314	0.458	0.988	0.019	-0.336	101	5
37	San Felipe	Maloma	-2.737	3.139	4.192	1.851	-1.434	0.002	0.468	26	2
38	San Felipe	Manglicmot	-0.045	1.187	1.326	0.490	0.681	1.129	0.565	19	6
39	San Felipe	Rosete	-1.707	-0.678	0.219	-0.176	1.220	0.928	-0.513	105	3
40	San Felipe	San Rafael	0.335	0.296	-0.056	-1.205	1.049	-0.566	0.098	65	1
41	San Felipe	Sindol	-0.585	0.964	0.411	-0.528	-1.067	1.252	0.052	71	5
42	San Felipe	Sto.Nino	0.346	-0.580	2.073	-1.268	1.225	-0.374	0.146	56	3
43	Cabangan	Anonang	0.147	0.740	-1.139	0.356	0.183	0.160	0.145	57	1
44	Cabangan	Apo-Apo	0.920	-0.437	-1.507	-1.875	-1.371	0.717	-0.220	93	1
45	Cabangan	Arew	0.733	-0.049	-0.989	-0.528	0.658	-0.619	0.059	69	2
46	Cabangan	Banuanbayo(pob.)	1.388	-2.090	-1.387	1.396	0.457	2.608	0.055	70	1
47	Cabangan	Cadmang-Reserva	-1.358	-0.786	-0.331	-0.102	1.515	-0.073	-0.525	106	3
48	Cabangan	Camiing	0.289	-0.104	-0.271	-0.780	0.679	-0.473	-0.017	79	1
49	Cabangan	Casabaan	1.589	-0.746	-1.314	-0.665	-0.160	-0.163	0.064	68	4
50	Cabangan	Del carmen	0.842	-1.534	-1.012	0.323	0.963	1.778	-0.036	80	1
51	Cabangan	Dolores	0.305	1.553	-1.438	1.161	-0.162	-0.363	0.367	36	1
52	Cabangan	Felmida-Diaz	0.233	-0.535	-2.029	0.722	0.836	0.169	-0.152	89	1
53	Cabangan	Laoag	-0.090	0.367	-1.052	0.788	1.075	-1.002	0.032	72	4
54	Cabangan	Lomboy	1.147	0.184	-1.605	-0.204	0.012	0.505	0.211	49	1
55	Cabangan	Longos	-0.066	0.407	-0.795	0.331	0.569	0.388	0.079	66	7
56	Cabangan	Mabanglit	0.028	0.588	-1.035	-1.463	-1.202	-0.128	-0.184	92	5
57	Cabangan	New San Juan	-1.084	-0.907	-0.329	-0.183	1.431	0.377	-0.462	104	1
58	Cabangan	San Antonio	0.861	-0.433	-0.689	-0.539	0.925	0.378	0.110	62	1
59	Cabangan	San Isidro	1.001	1.167	-0.189	-0.386	0.466	-0.378	0.524	21	1
60	Cabangan	San Juan(pob)	-0.836	-0.578	0.399	-0.760	1.367	0.492	-0.280	99	1
61	Cabangan	San Rafael	0.043	-0.328	-0.890	-0.280	0.585	0.909	-0.097	87	1
62	Cabangan	Sta.Rita	0.439	-0.002	-0.097	-0.729	0.892	-0.083	0.110	61	1
63	Cabangan	Sto.Nino	-0.333	-0.252	-0.469	-1.791	-0.694	1.084	-0.352	102	5
64	Cabangan	Tondo	1.077	-0.296	-1.176	-0.794	0.150	-0.859	0.008	76	1
65	San Narciso	Alusiis	0.518	0.547	-0.694	0.219	0.936	-0.917	0.236	45	1
66	San Narciso	Beddeng	1.270	5.236	2.128	2.322	-1.481	-0.625	1.905	1	1
67	San Narciso	Candelaria	2.411	-2.634	0.523	0.145	-0.243	-0.559	0.103	64	1
68	San Narciso	Dallipawen	1.675	3.088	-1.890	1.579	-1.119	-0.785	1.025	6	1
69	San Narciso	Grullo	0.950	2.296	0.079	0.485	-0.225	-0.453	0.829	10	1
70	San Narciso	La Paz	1.679	-1.263	0.175	3.660	-0.006	5.226	0.815	11	1
71	San Narciso	Libertad	3.440	-5.280	1.683	1.448	-1.056	-0.629	-0.041	81	7
72	San Narciso	Namatacan	1.293	2.912	-0.460	0.505	-1.201	-0.504	0.946	7	6
73	San Narciso	Natividad	0.784	0.411	0.191	-0.423	0.820	0.256	0.380	35	1
74	San Narciso	Omaya	-1.825	0.234	-0.025	1.055	0.311	1.017	-0.309	100	5
75	San Narciso	Paite	1.508	2.690	-2.028	2.523	-1.496	1.083	1.027	5	1
76	San Narciso	Patro cinio	0.987	0.979	0.398	-0.550	0.592	-0.323	0.537	20	2
77	San Narciso	San Jose	3.516	-5.602	1.579	1.870	-1.154	-0.709	-0.081	86	1
78	San Narciso	San Juan	0.778	-0.126	-0.238	-0.655	0.642	0.051	0.161	55	1
79	San Narciso	San Pascual	0.843	0.203	-0.349	-0.465	0.313	-1.249	0.167	53	1
80	San Narciso	San Rafael	1.500	-0.975	0.130	-0.647	0.425	-0.354	0.174	51	4
81	San Narciso	Simminublan	1.634	4.870	-0.235	2.558	-1.783	-1.290	1.627	2	3
82	Castellejos	Buenayista	0.673	2.717	-2.269	2.445	-0.879	-1.517	0.656	14	2
83	Castellejos	Looc	0.862	1.187	-0.488	-0.344	0.102	-0.194	0.444	29	1
84	Castellejos	Magsaysay	0.705	1.371	0.968	-0.796	0.178	-0.060	0.575	18	1
85	Castellejos	Nagbayan	0.495	1.290	0.164	-0.209	0.107	-0.001	0.455	27	3
86	Castellejos	Nagbunga	1.135	-0.029	-0.394	-0.817	0.471	-0.068	0.238	44	3
87	Castellejos	San Agustin	0.706	1.142	1.677	-0.600	0.752	-0.253	0.645	16	3
88	Castellejos	San Jose	0.701	0.506	0.872	-0.484	0.831	0.130	0.442	30	2
89	Castellejos	San Juan	1.521	-0.894	-0.522	0.014	0.315	-0.049	0.195	50	1
90	Castellejos	San Nicolas	0.515	-0.600	0.340	-2.546	-1.135	0.060	-0.251	96	7
91	Castellejos	San Pablo	-2.791	1.134	3.929	-0.213	0.709	0.450	-0.057	84	1
92	Castellejos	San Roque	1.258	-1.947	0.642	-0.131	0.551	0.119	0.010	73	1
93	Castellejos	Sta.Maria	1.199	0.251	-0.278	-0.870	0.532	-0.394	0.317	42	2
94	Iba	Dirita	0.474	1.952	1.302	-0.945	-0.647	0.114	0.621	17	6
95	Iba	Lipay Dingin	0.573	-0.456	0.429	-0.918	0.947	-0.271	0.077	67	5
96	Iba	Palanginan	0.352	3.582	3.503	0.880	-0.260	-0.244	1.378	3	1
97	Iba	Sta Barbara	0.028	1.967	1.274	0.438	0.235	-0.392	0.645	15	6
98	Iba	Sto Rosario	0.498	-0.935	1.069	-1.010	0.748	-1.046	-0.052	83	1
99	Iba	Zone1	1.119	-0.663	0.227	-0.589	0.794	-0.663	0.161	54	1
100	Iba	Zone2	4.274	-6.006	2.095	1.501	-1.542	-1.557	-0.005	78	1
101	Iba	Zone3	3.379	-4.922	0.717	1.847	-0.998	0.264	0.007	77	5
102	Iba	Zone4	3.905	-5.444	1.374	1.624	-1.322	-0.804	0.009	75	4
103	Iba	Zone5	2.781	-4.070	2.050	0.337	-0.434	-1.175	0.009	74	1
104	Iba	Zone6	1.246	-0.414	-0.944	0.036	0.539	0.186	0.212	48	1
105	San Marcelino	Aglao	-2.928	-0.942	0.402	-1.565	-0.144	0.469	-1.150	111	3
106	San Marcelino	Buhawen	-2.839	-1.257	0.413	-1.137	-0.081	1.439	-1.103	110	3
107	San Marcelino	Burgos	0.471	-0.185	0.588	-0.728	0.995	0.119	0.170	52	1
108	San Marcelino	Central(pob.)	2.088	-3.613	0.751	0.037	-1.440	0.490	-0.232	94	2
109	San Marcelino	Consuelo Norte	0.683	0.448	-0.515	-1.362	-0.447	0.384	0.120	60	1
110	San Marcelino	Consuelo Sur	1.252	-1.237	0.089	-1.233	-0.658	0.136	-0.063	85	1
111	San Marcelino	La Paz	1.114	0.160	-0.959	-1.321	-0.639	0.183	0.108	63	3
112	San Marcelino	Laoag	-0.056	0.565	0.327	-0.731	0.490	0.003	0.123	58	1
113	San Marcelino	Linasin	0.898	0.672	0.067	-1.160	0.254	-0.261	0.329	41	2
114	San Marcelino	Linusungan	1.404	2.531	-1.034	-0.071	-1.326	-0.486	0.768	12	3
115	San Marcelino	Lucero	0.578	-0.303	-0.111	-1.293	-0.440	0.183	-0.048	82	4
116	San Marcelino	Nagbunga	0.914	2.056	0.507	0.795	0.059	0.548	0.910	8	6
117	San Marcelino	Rabanes	0.222	1.569	0.076	0.444	-0.570	0.983	0.496	23	3
118	San Marcelino	Rizal	1.136	1.019	-1.157	-0.645	-1.005	0.448	0.343	39	1
119	San Marcelino	San Guillermo	1.365	1.399	-1.500	-0.563	-1.265	0.140	0.434	32	2
120	San Marcelino	San Isidro	1.159	1.638	-0.703	-0.868	-1.085	-0.043	0.494	24	2
121	San Marcelino	San Rafael	-2.562	0.923	1.600	1.073	0.090	0.274	-0.237	95	1
122	San Marcelino	Sta.Fe	-4.807	0.057	2.232	-0.892	-3.534	0.781	-1.419	112	1

Table 3.2.1 List of CBFM Projects in the Study Area

NAME OF PO	TYPE	LOCATION	NAME OF CHAIRMAN	AREA AWARDED (HA.)	DATE ISSUED	CBFMA #
01. Cabaruan Multi-Purpose Coop.	CBFMA	Cabaruan, Feria, San Felipe, Zambales	Charito Sebastian	335.0	January 27, 1999	30202015
02. Anak Maralita ng Pinatubo Uunlad ng Nagkakaisa, Inc.	CBFMA	Nilumbangan, Botolan, Zambales	Franklin Dequina	1,020.58	October 28, 1999	30202024
03. Sento sa Pamamahala ng Pamayanang Mambikap, Inc.	CSD to CBFMA	Mambog, Botolan, Zambales	Arturo Pacheco	289.0	January 27, 1999	30202017
04 Samahang Katutubo ng Palis Tungo sa Pag-unlad	CBFMA	Loob-bunga Ressetlement, Botolan Zambales	Warlito Cruzado	426.836	December 28, 1999	30202034
05. Balincaguing Upland Farmers Assn.	CSC to CBFMA	Balincaguing, San Felipe, Zambales	Igmedio de Dios	205.0	January 9, 1999	30202029
06. Mt. Mabanghil Hillside Developers Assn.	CSC to CBFMA	Owaog, Nibloc, Botolan, Zambales	Wilson Fronda	127.791	September 29, 2000	30202050
07. Bucao Tribal Council	CBFMA	Bucao, Botolan, Zambales	Rosita Cabalic	97.26	December 12, 1999	30202064
08. LALEC Upland Farmers Assn.	CSC to CBFMA	Sindol, San Felipe, Zambales	Reynaldo Pulido	200.644	Deember 1, 2000	30202066
09. Aglao Upland Farmers Assn.	CBFMA	Batiawan, Alpay, San Isidro, Subic Castillejos, San Marcelino, Zambales	Josephine Olda	4,998.85	February 27, 2000	30202045
10. Mt. Dutdut Upland Farmers Assn. Inc.	CBFMA	Aglao, San Marcelino, Zambales	Crisanta Cuevas	4,595.46	February 18, 2000	30202044
11. Malomboy-Biangue Upland Farmers Association	CSC to CBFMA	Malomboy-Biangue, Botolan, Zambales	Jose Manalan	517.83	December 31, 2001	30202088
12. Pagkakaisa ng Aeta ng Pinatubo	CBFMA	Bucao, Porac, Botolan, Zambales	Chito Balintag	54.24	December 2002	30202094
13 Anonang Upland Farmers Association inc. (AUFAI)	CBFMA	So. Dusoc and Dalig, Anonang, Cabangan, zambales	Mario Reyes	113.3		
14 Cabangan Kabataan Forest Developers Assocaiton	CBFMA	So. Apalit, longos, Cabangan, Zambales	Feliciano Catolico Jr.	73.745		
15 Bucao Tribal Council	CBFMA	So. Pamalasan, Porac, Botolan, Zambales	Rosita Cabalic	97.06		
16 Anak Maralita ng Pinatubo Uunlad na Nagkakaisa	CBFMA	So. Nilumbagan, Malomboy, Botolan, Zambales	Frank Dequina	1026.53		
17 Sentro sa Pamamahala ng Pamayanang Mambikap, Inc. (SPPMI)	CBFMA	So. Mamala, Mambog, Botolan, Zambales	Arturo Pacheco	289.0		
18. Zambales Cooperative Federation (ZACOFED)	CBFMA	So. Nabuje and Nibloc, Owaog, Botolan, Zambales	Gregorio Bolasco	164.0		
19. San Roque Community Management Center, Inc.	CBFMA	So. Baculi and Reserva, Cadmang, Cabangan, Zambales	Alberto Diago	222.5		
20. Samahang Katutubo ng Paliz Tungo sa Pag-unlad	CBFMA	So. Bihawo, Loob-bunga, Mambog, San Juan, Botolan, Zambales	Ferdinand Luzano	426.836		
21. Binuclotan Fisherfolk Association	CCFS	So. Pamalasan, Binoclutan Botolan, Zambales	Leonardo M. Valensula	20.80		
22. Lubos na Alyans ng katutubong Ayta ng San Lakas (LAKAS)	CCFS	So. Bihawo, Mambog,Botolan, Zambales	Carlito Domulot	48.00		
23. New San Juan Upland Farmers Association	CSC	So. Kasoy, New San Juan, Cabangan Zambales	Dionisio Areniego	38.00		
24. Longos Upland Farmers Assn.	CSC	So. Apnit, Longos, Cabangan, Zambales	Feliciano Catolico Sr.	87.36		
25. Cadmang Upland Farmers Assn.	CSC	So. Reserva, Cadmang Cabangan, Zambales	Santiago Manalan	120.0		
26 San Rafael Upland Farmers Association	CSC	San Rafael, Cadmang Cabangan, Zambales	Julito Castillo	93.23		
27. Mabanglit Upland Farmers Association	CSC	So. Maligaya, Mabanglit Cabangan, Zambales	Salvador Buratao	356.27		
28 Kagamutan Upland Farmers Assn.	CSC	So. Kagamutan, Panan, Botolan, Zambales	Santiago Mayo	57.60		
			Total Area	**16,380.69**		

Table 3.2.2 Monitoring and Evaluation of CBFM Projects in the Study Area (Based from the PENRO Reports)

Name of PO	Tenurial Instrument	Areas Development and Management				Socio-economic Advancement		Remarks
		Area Planted/ Developed Maintenance	Species Planted	Forest Area	Existing Forest Product	Livelihood	Livelihood Training	
Cabaruan, Mulit-Purpose Cooperative	CBFMA	130.0	EU,A,AC	15.0	-	-	-	PO is active
Bukluran ng Ugnayan para sa Kalikasan at Likas Yaman	CBFMA	20	M,B	100	Dipterocarp Spp.	Upland Farming Mango Plantation	-	
Mabanglit Upland Farmers Association	CSC	200	M,C,J,D	-	-	Cogon Gathering	-	needs other source of income
Samahan ng tribong Dangla	CCFS	10	B,C, M	-	-	-	-	No sustainability of project
samahan ng Maliliit na Mag-sasaka sa Mataas na Lupa	CCFS	5	AG,A,C J,M	-	-	-	-	Program Lapsed
Loob-bunga Tree Farmers Association	CCFS	-	-	-	-	-	-	Loose and no contuity
Binoclutan Small Fisherfolks Inc.	CCFS	-	-	-	-	-	-	No developmental activities
Loob-bunga Youth Development Cooperative	CCFS	-	-	-	-	-	-	Discontinued development
Lubos na Alyansa ng Katutubong Ayta	CCFS	48	AG,A,M C,G,EU	10	-	-	Value formation Organization building	Project still needed for sustainance
Bucao Tribal Council	CBFMA	29	MH,M,C,BN	2	LUAN, PALUSAPIS	-	-	PO is active
Longos Upland Farmers Association	CSC	87.6	AG,EU,M,C	7	NONE	-	Agro-forestry	PO is active
Anonang Upland Farmers Assn.	CSC	59	AG,N,EU,MN	-	-	-	-	PO is active
Bagong Buhay Upland Farmers Assn.	CSC	7	EU,MN,C	32	LUAN, SAKAT	-	-	PO is active
Binoclutan Fiherfolks Association	CSC	7	J,M,MH,G	-	-	-	-	Needs financial Assistance
San Roque Community Management Center Inc.	CBFMA	150	MH,MN,AG EU,N	-	-	goat raising	Sasso	PO is active
Samahang Katutubo ng Palis	CBFMA	200	MH,M,C, BN,COCO	-	-	-	-	PO is active
Cabangan Kabataan Forest Development		25	AG,MN,EU	-	-	-	-	PO is active

* EU-Eucalyptus
A-Acheute
AC-Acacia
J- jackfruit
D-Durian
G- Gemelina
M- Mango
B-Bamboo
C-Cashew
BN- Banana
AG- Agoho
MH- Mahogany
N- Narra
MN-Mangium

Table 3.2.3 Economic Evaluation on CBFM Program for Community Based Disaster Prevention Activities

Year	Cost			Benefit					B-C
	Re-forestation		Agro-forestry	Stumpage	Agro-forestry			Sediment	
	Initial Development Cost (mil.Pesos)	Replacement Cost (mil.Pesos)	(mil.Pesos)	of Tree-Plantation 18,370 ha (mil.Pesos)	Mango 1,470 ha (mil.Pesos)	Cashew 1,102 ha (mil.Pesos)	Corn 1,102 ha (mil.Pesos)	Reduction (mil.Pesos)	(mil.Pesos)
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
1	207.948	0.000	58.508	0.000	-7.125	-5.767	0.000	0.000	-279.348
2	149.716	0.000	30.693	0.000	-4.515	-3.809	2.010	0.000	-186.721
3	67.785	0.000	16.900	0.000	-4.515	-6.468	4.021	0.000	-91.647
4	34.976	0.000	10.368	0.000	-3.915	-4.100	6.341	0.000	-47.019
5		0.000		0.000	-3.994	-1.403	8.661	0.000	3.263
6		0.000		0.000	-5.930	2.630	8.661	0.000	5.361
7		0.000		0.000	-5.457	6.047	8.661	0.000	9.251
8		0.000		0.000	-4.670	8.528	8.661	0.000	12.518
9		0.000		437.735	1.534	11.720	8.661	0.000	459.650
10		207.948		437.735	14.462	15.415	8.661	46.000	314.325
11		149.716		437.735	46.372	19.111	8.661	46.000	408.163
12		67.785		437.735	91.431	22.475	8.661	46.000	538.516
13		34.976		437.735	135.459	24.956	8.661	46.000	617.834
14		0.000		0.000	172.596	24.956	8.661	46.000	252.212
15		0.000		0.000	218.577	24.956	8.661	46.000	298.193
16		0.000		0.000	232.301	24.956	8.661	46.000	311.918
17		0.000		0.000	247.513	24.956	8.661	46.000	327.130
18		0.000		437.735	265.408	24.956	8.661	46.000	782.760
19		207.948		437.735	282.162	24.956	8.661	46.000	591.565
20		149.716		437.735	294.930	24.956	8.661	46.000	662.566
21		67.785		437.735	294.630	24.956	8.661	46.000	744.196
22		34.976		437.735	290.356	24.956	8.661	46.000	772.731
23		0.000		0.000	289.757	24.956	8.661	46.000	369.373
24		0.000		0.000	289.757	24.956	8.661	46.000	369.373
25		0.000		0.000	289.757	24.956	8.661	46.000	369.373
26		0.000		0.000	289.457	24.956	8.661	46.000	369.073
27		0.000		0.000	285.783	24.956	8.661	46.000	365.399
28		0.000		437.735	285.783	24.956	8.661	46.000	803.134
29		0.000		437.735	285.783	24.956	8.661	46.000	803.134
30		0.000		437.735	285.783	24.956	8.661	46.000	803.134
NPV (15%)	205.03	74.85	52.10	352.22	146.25	18.96	22.46	45.21	253.12
EIRR									**21.5%**

Table 3.3.1 Results of Laboratory Test of Soil Samples for Lahar Agriculture Research

Soil sampling Point	River Location	Municipality	Barangay	Sitio	Coordinates						Elevation		Lahar Condition	Area	Previous land cover	Curent land cover	Laboratory Test Results									
					Longitude (E)			Latitude (N)			Before	Present					pH	OM	P	K cmol (+)/kg soil	CEC cmol (+)/kg soil	Fe	Zn	Cu	Mn	SO4
					deg	min	sec	deg	min	sec	(El.m)	(El.m)		(ha)				(%)	(ppm)			(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
1a	Bucao, middle, Left	Botolan	Poonbato		120	10	35	15	15	7	98	115	Fine lahar	500	Scrub/grass	Scrub/grass/some cultivated	5.7	3.61	175	0.13	8.2	10	1	5	13	23.04
1b	Bucao, middle, Left	Botolan	Poonbato		120	10	35	15	15	7	98	115	Fine lahar	500	Scrub/grass	Scrub/grass/some cultivated	7.3	0.13	2	0.09	1.3	6	2	3	21	38.14
3	Bucao, lower, Right	Botolan	Baquilan		120	4	51	15	16	38	15	33	lahar w/pumice	160	scrub/grass	pioneer plant (talahib)	6.6	0.33	11	0.15	3.3	37	3	9	47	110.97
4	Bucao, lower, Right	Botolan	Baquilan		120	4	41	15	16	35	15	28	lahar w/pumice	160	Scrub	No plant	7.6	0.16	7	0.08	1.4	8	1	2	19	110.97
5	Bucao, lower, outside of dike	Botolan	San Juan		120	2	58	15	16	47	10	15	swampy lahar	205	Rice	Pionner plant (talahib)	3.5	0.66	96	0.1	2.8	433	2	8	41	1263.4
6	Balin Baquero, right	Botolan	Poonbato		120	11	0	15	13	45	90	103	lahar w/pumice	365	Scrub	No plant	6.7	0.05	5	0.1	1.4	7	1	3	29	156.85
7	Balin Baquero, right	Botolan	Poonbato		120	10	20	15	13	30	90	103	lahar w/pumice	365	Scrub	No plant	6.9	0.28	3	0.08	1.1	6	2	3	30	173.61
8	Maloma, middle, left	San Felipe	Maloma	Kakilingan	120	5	57	15	6	42	10	28	lahar w/pumice	125	Scrub	pioneer plant (talahib)	6.6	0.24	5	0.1	1.9	35	3	6	42	53.94
9	Maloma, middle, left	San Felipe	Maloma	Kakilingan	120	6	19	15	5	25	10	28	lahar w/pumice	50	Rice	No plant	7.9	0.04	2	0.05	2.5	12	2	2	29	23.04
10	Mapanuepe, north, lakeside	San Marcelino	Buhawen	Lawak Banga	120	18	29	14	59	38	140	141	Fine lahar	65		Rice, Sugarcane	6.2	1.52	70	0.17	12.2	263	4	7	104	106.23
11	Marella, left	San Marcelino	Aglao		120	16	48	14	59	56	130	149	lahar w/pumice	450	Tropical grass	No plant	6.5	0.06	3	0.06	1.1	6	2	4	20	110.97
12	Marella, right	San Marcelino	Santa Fe		120	15	25	14	59	58		135	lahar w/pumice	200	Scrub, grass	pioneer plant (talahib)	6.1	0.11	91	0.05	5.6	9	1	3	16	26.75
13	Sto.Tomas, middle, right	San Marcelino	Santa Fe		120	14	19	15	0	6	100	117	Fine lahar	100	Tropical grass	Pineapple, sweet potate	5.8	1.17	114	0.11	3.1	35	1	3	12	42.02
14	Sto.Tomas, middle, right	San Marcelino	Santa Fe		120	13	15	15	0	23	70	101	lahar w/pumice	200	Rice	pioneer plant (talahib)	6.3	0.36	114	0.08	1.4	11	1	3	13	15.72
15	Sto.Tomas, middle, spur dike	San Marcelino	San Rafael		120	13	46	14	58	47	70	97	lahar w/pumice	200	Tropical grass	pioneer plant (talahib)	5.7	0.28	123	0.09	2.2	11	4	10	38	130.61
16	Sto.Tomas, middle, left	San Marcelino	San Rafael		120	13	37	14	58	23	60	97	lahar w/pumice	200	Tropical grass	No plant	6.4	0.22	74	0.07	2.4	9	4	16	32	162.35
17	Sto.Tomas, middle island	San Marcelino	Santa Fe		120	11	45	15	0	5	50	74	lahar w/pumice	200	Tropical grass	pioneer plant (talahib)	6.1	0.54	169	0.19	4.5	208	5	19	64	657.72
18	Sto.Tomas, middle, left out of	San Marcelino	Rabanes		120	11	12	14	58	56	44	66		30	Rice, vegetable	Rice, vegetable	4.3	2.15	104	0.12	5.5	78	4	37	55	1043.1
19	Sto.Tomas, lower, left out of river	San Narciso	Namatacan	Feliciana	120	6	58	15	1	9	10	27	lahar w/pumice	65	Rice	Rice, grass, agojo	4.3	0.27	91	0.1	0.79	74	2	8	22	385.92
20	Sto.Tomas, lower right out of river	San Felipe	Paete		120	6	29	15	1	48	10	20	fine lahar	20	Rice	Rice, agojo, sweet potato, peanut	5.6	1.26	169	0.25	7.5	285	3	20	32	787.81
21	Sacobia, upstream	Mabalacat	Calumpang		120	31	32	15	13	8	150	173	fine lahar		Rice, Suarcane	Sugarcane, perennials	5.1	2.28	164	0.29	5.8	42	2	6	17	62.12
22	Sacobia-Bamban	Concepcion	Fan Francisco	Dawe	120	38	2	15	17	44	40	47	lahar w/pumice		Rice	Pionner plant	6.8	0.14	6	0.07	1.7	14	2	4	36	222.78
23a	Abacan, levee	Angeles	Sapalibutad		120	37	32	15	8	58	40	64	quarry material		Rice	Rice	6.9	0.42	865	0.07	1.3	95	2	2	33	62.12
23b	Abacan, levee	Angeles	Sapalibutad														6.2	0.79	109	0.11	2	10	2	3	17	15.72
24	Pasig-Potrero, inside megadike	Bacolor	Sta.Barbara		120	38	32	15	0	13	10	24	fine lahar		Rice	Rice, Mango, watermelon	6.7	0.36	9	0.37	5.6	168	5	23	121	858.38
25	Pasig-Potrero, inside megadike	Bacolor	San Antonio		120	38	13	15	1	33	11	23	fine lahar		Rice	pioneer plant (talahib), fishpond,	7.2	0.54	21	0.14	1.9		2	7	34	522.83

Table 3.3.2 Laboratory Results of the Groundwater Survey of Water Wells

	Parameter	Unit	Stn 3	Stn 4A	Stn 6A	Stn 15A	Stn 18A	Stn 20a
1	Arsenic	mg/L	ND	0.57	ND	ND	ND	ND
2	Cadmium	mg/L	ND	ND	ND	ND	ND	ND
3	Calcium	mg/L	ND	ND	ND	18	35	41
4	Chloride	mg/L	9.4	15	5.8	12	16	16
5	Chromium VI	mg/L	ND	ND	ND	ND	ND	ND
6	Copper	mg/L	ND	ND	ND	ND	ND	ND
7	Cyanide	mg/L	ND	ND	ND	ND	ND	ND
8	Fluoride	mg/L	ND	ND	ND	ND	ND	ND
9	Iron	mg/L	0.33	0.34	0.39	0.33	0.43	0.51
10	Lead	mg/L	ND	ND	ND	ND	ND	ND
11	Magnesium	mg/L	10	63	29	216	86	60
12	Manganese	mg/L	ND	ND	ND	ND	0.66	0.08
13	Mercury	mg/L	0.24	0.14	1.45	0.43	0.63	1.54
14	Nitrate	mg/L	0.17	0.22	0.08	0.09	0.07	0.06
15	Nitrite	mg/L	ND	ND	ND	ND	ND	ND
16	Nitrogen	mg/L	<0.09	64	47	41	37	57
17	Phosphorus	mg/L	0.52	0.15	0.09	ND	0.06	0.18
18	Sulfate	mg/L	34	180	33	252	428	315
19	Zinc	mg/L	ND	0.05	0.29	0.1	1.4	0.11
20	Phenols	mg/L	ND	ND	ND	ND	ND	ND
21	Conductivity	uS/cm	210	700	330	760	1,120	990
22	pH		7.7	7.1	7.2	6.5	6.4	7.2
23	Temperature	mg/L	27.8	27.6	27.5	27.9	28	27.8
24	COD	mg/L	1080	345	887	641	1080	887
25	DO	mg/L	3.3	1.8	3	5	2	2
26	Color	PCU	5	5	6	6	5	5

Table 3.3.3 Cost Estimate for River Training Works for Lahar Agriculture Development

Area No.	Location	Barangay	Area (ha)	Training Dike			Separation Dike			Total	
				Unit Rate	Quantity	Amount	Unit Rate	Quantity	Amount		
Area-1	Bucao, middle (Right)	Poonbato	225	31,240.02	900	28,116,018	8,053.32	4,000	32,213,280	60,329,298	
Area-2	Bucao, Middle (Right)	Malomboy	31	31,240.02	1,500	46,860,030	8,053.32	1,300	10,469,316	57,329,346	
Area-3(*1)	Bucao, D-stream (Right)	San Juan	200	31,240.02	0	0	8,053.32	0	0	0	(*1)
Area-4	Bucao, D-stream (Right)	San Juan	120	31,240.02	2,400	74,976,048	8,053.32	0	0	74,976,048	
Area-5	Marella, Left	Aglao	300	31,240.02	1,500	46,860,030	8,053.32	0	0	46,860,030	
Area-6	Sto-Tomas, middle (Righ	Santa Fe	600	31,240.02	500	15,620,010	8,053.32	0	0	15,620,010	
Area-7	Sto-Tomas, middle (Left)	San Rafae	250	31,240.02	5,000	156,200,100	8,053.32	0	0	156,200,100	
	TOTAL		1726			368,632,236			42,682,596	411,314,832	

Notes: (*1) Drainage improvement cost (P.48,675,385)is not included

For Gabion Made Training Dike (per m)

Item No.	Work Item	Unit	Quantity	Unit Price	Amount
1	Lahar Excavation	m3	6.00	54.66	327.96
2	Gabion	m3	14.00	2,172.29	30,412.06
3	Bolder pitching	m3	1.00	500.00	500.00
	Total Unit Cost per m				31,240.02

For Separation Dike (per m)

Item No.	Work Item	Unit	Quantity	Unit Price	Amount
1	Lahar Embankment	m3	24.00	94.00	2,256.00
2	Covering borrow soil	m3	12.00	419.65	5,035.80
3	Sodding	m2	13.4	56.83	761.52
	Total Unit Cost per m				8,053.32

Table 3.3.4 Market Price, Expenses and Net Income for Selected Crop Produces

No.	Item	unit	Rice-direct seeded	Corn	Sweet potato	Mung-bean	Peanut	Water-melon	Squash	Tomato	Garlic	Onion	Cassava	Gabi
1	Gross Yield	kg/ha	3,680	5,810	18,600	1,000	2,000	15,000	6,000	27,000	10,000	15,000	18,000	15,000
2	Market Price	Peso/kg	16.00	7.00	12.00	30.00	25.00	15.00	12.00	15.00	30.00	25.00	5.00	2.00
	Total Revenue	**Pesos/ha**	**58,880**	**40,670**	**223,200**	**30,000**	**50,000**	**225,000**	**72,000**	**405,000**	**300,000**	**375,000**	**90,000**	**30,000**
3	Expenses													
	a) Labor	Pesos	5,750	10,925	11,325	12,200	14,825	12,250	13,350	19,675	27,750	43,750	20,600	10,125
	b) Material Inputs	Pesos	14,206	16,048	22,416	5,366	7,790	15,792	17,706	29,754	60,250	35,306	13,920	10,800
	Total Expenses	**Pesos/ha**	**19,956**	**26,973**	**33,741**	**17,566**	**22,615**	**28,042**	**31,056**	**49,429**	**88,000**	**79,056**	**34,520**	**20,925**
4	**Net Income**	**Pesos/ha**	**38,924**	**13,697**	**189,459**	**12,434**	**27,385**	**196,958**	**40,944**	**355,571**	**212,000**	**295,944**	**55,480**	**9,075**

Souce: Aganon, C.et.al. 1995, Crop Production Technologies in Ash and Lahar Laden Areas.

Table 3.3.5 Construction Cost for Farm Land on Lahar Covered Riverside Area

Area-1 : Bucao, Mid-Stream, Right Side (Barangay Poonbato)
Development Area: 225 ha

No	Item	Unit	Unit Rate	Quantity	Amount
1	River Training Work	L.S.	60,329,298	1	60,329,298
2	Land Development	ha	16,500	225	3,712,500
3	Soil Improvement	ha	5,200	225	1,170,000
4	Fertilizer Provision	ha	9,980	225	2,245,500
5	Water Supply System	unit	59,500	45	2,677,500
	TOTAL				70,134,798
	Project Cost				92,577,933

Area-2 : Bucao, Mid-Stream, Right Side (Barangay Malomboy)
Development Area: 31 ha

No	Item	Unit	Unit Rate	Quantity	Amount
1	River Training Work	L.S.	57,329,346	1	57,329,346
2	Land Development	ha	16,500	31	511,500
3	Soil Improvement	ha	5,200	31	161,200
4	Fertilizer Provision	ha	9,980	31	309,380
5	Water Supply System	unit	59,500	7	416,500
	TOTAL				58,727,926
	Project Cost				77,520,862

Area-3 : Bucao, Downstream, Right Side at Swampy Area (Barangay San Juan)
Development Area: 200 ha

No	Item	Unit	Unit Rate	Quantity	Amount
1	River Training Work	L.S.	48,675,385	1	48,675,385
2	Land Development	ha	16,500	200	3,300,000
3	Soil Improvement	ha	5,200	200	1,040,000
4	Fertilizer Provision	ha	9,980	200	1,996,000
5	Water Supply System	unit	59,500	40	2,380,000
	TOTAL				57,391,385
	Project Cost				75,756,628

Area-4 : Bucao, Downstream, Right Side at River Area (Barangay San Juan)
Development Area: 120 ha

No	Item	Unit	Unit Rate	Quantity	Amount
1	River Training Work	L.S.	74,976,048	1	74,976,048
2	Land Development	ha	16,500	120	1,980,000
3	Soil Improvement	ha	5,200	120	624,000
4	Fertilizer Provision	ha	9,980	120	1,197,600
5	Water Supply System	unit	59,500	24	1,428,000
	TOTAL				80,205,648
	Project Cost				105,871,455

Area-5 : Marella River, Left Side facing Mapanuepe Lake (Barangay Aglao)
Development Area: 300 ha

No	Item	Unit	Unit Rate	Quantity	Amount
1	River Training Work	L.S.	46,860,030	1	46,860,030
2	Land Development	ha	16,500	300	4,950,000
3	Soil Improvement	ha	5,200	300	1,560,000
4	Fertilizer Provision	ha	9,980	300	2,994,000
5	Water Supply System	unit	59,500	60	3,570,000
	TOTAL				59,934,030
	Project Cost				79,112,920

Area-6 : Sto-Tomas, Middle stream, Right Side (Barangay Santa Fe)
Development Area: 600 ha

No	Item	Unit	Unit Rate	Quantity	Amount
1	River Training Work	L.S.	15,620,010	1	15,620,010
2	Land Development	ha	16,500	600	9,900,000
3	Soil Improvement	ha	5,200	600	3,120,000
4	Fertilizer Provision	ha	9,980	600	5,988,000
5	Water Supply System	unit	59,500	120	7,140,000
	TOTAL				41,768,010
	Project Cost				55,133,773

Area-7 : Sto-Tomas, Middle stream, Left Side (Barangay San Rafael)
Development Area: 250 ha

No	Item	Unit	Unit Rate	Quantity	Amount
1	River Training Work	L.S.	156,200,100	1	156,200,100
2	Land Development	ha	16,500	250	4,125,000
3	Soil Improvement	ha	5,200	250	1,300,000
4	Fertilizer Provision	ha	9,980	250	2,495,000
5	Water Supply System	unit	59,500	50	2,975,000
	TOTAL				167,095,100
	Project Cost				220,565,532

Table 3.4.1 Results of Water Quality Survey at Mapanuepe Lake and the Reservoir of Dizon Mine Tailing Dam

ITEM NO.	LABORATORY TEST ITEM	UNIT	METHODS OF ANALYSIS	Sampling Location/Results										Standards	
				Dizon Mining Dam		Mapanuepe Lake									
				A. Reservoir Area		B. U/S near dam		C. Central area		D. D/S near channel		E. Inlet area			
				Surface	Mid-depth	Surface	Mid-depth	Surface	Mid-depth	Surface	Mid-depth	Surface	Mid-depth		
Total Water Depth during sampling				14.9 meters		11.0 meters		14.0 meters		4.0 meters		13.0 meters		Class C	Class D
1	PH	-	PH meter (determined on-site)	3.57	4.19	6.3	6.16	6.02	6.26	6.36	6.65	6.23	6.56	6.5-8.5	6.0-9.0
2	BOD_5	mg/l	Azide Modification (5-day@20 C)	1.0	1.0	3.0	2.0	1.0	1.0	6.0	1.0	3.0	2.0	7	10
3	COD	mg/l	Open reflux Dichromate	9	9.0	9.0	9.0	12	8.0	16.0	16.0	12.0	16.0	100	200
4	Dissolve Oxygen	mg/l	Azide modification	8.4	8.3	8.2	7.7	8.4	8.1	8.0	7.3	7.3	8.1	5.0(min)	3.0 (min)
5	Colour	PCU	Visual Comparison	15.0	25.0	20.0	25.0	25.0	15.0	25.0	25.0	20.0	15.0	150	None
6	NO_2^- N	mg/l	Colorimetric	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	None	None
7	NO_3^- - N	mg/l	Colorimetric	7.6	7.9	1.6	1.4	0.96	1.0	0.46	0.66	<0.40	<0.40	10	None
8	NH_4^- - N	mg/l	Titrimetric	0.12	0.08	<0.01	0.04	0.01	0.01	0.05	<0.01	<0.01	0.01	None	None
9	Chlorides (Cl)	mg/l	Titrimetric	1.4	1.4	6.1	6.8	6.8	6.4	7.0	7.0	6.2	6.4	350	350*
10	Cyanide (Cn)	mg/l	Ion-Selective	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	None
11	Mercury (Hg)	mg/l	AAS, ColdVapor Technique	0.26	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	0.42	<0.0004	<0.0004	<0.0004	0.002	0.002
12	Phosphorous (P)	mg/l	Colorimetric	0.16	0.19	<0.16	0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	0.4	None
13	Sulfate (SO4)	mg/l	Colorimetric	130.0	138.0	80.0	75.0	80.0	81.0	92.0	96.0	74.0	79.0	None	None
14	Iron (Fe)	mg/l	AAS	579.9	617.0	0.14	0.32	0.16	0.10	0.11	0.13	0.09	0.05	None	5.0*
15	Manganese (Mn)	mg/l	AAS	880.0	880.0	361.0	341.0	331.0	310.0	310.0	320.0	268.0	259.0	None	0.2*
16	Zinc (Zn)	mg/l	AAS	1.7	1.7	0.31	0.32	0.32	0.45	0.28	0.30	0.30	0.32	None	2.0*
17	Lead (Pb)	mg/l	ASV	0.06	0.06	0.11	0.07	0.10	0.14	0.14	0.12	0.15	0.15	0.05	5.0*
18	Chromium (Cr (VI))	mg/l	Colorimetric	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.05	0.01
19	Cadmium (Cd)	mg/l	ASV	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.01	0.05
20	Arsenic (As)	mg/l	AAS, Hydrite generation	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	0.01
21	Fluoride (Fl)	mg/l	Colorimetric	0.95	1.0	0.60	0.54	0.52	0.72	0.80	0.50	0.53	0.50	None	1.0
22	Phenols	mg/l	Colorimetric	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	0.03	0.02	None
23	Calcium (Ca)	mg/l	AAS, Flame	64.2	61.2	63.8	63.4	63.0	63.8	87.0	84.0	62.0	62.0	None	None
24	Magnesium (Mg)	mg/ml	AAS, Flame	40.8	49.0	32.0	38.0	38.0	38.0	43.0	46.0	41.0	49.0	None	None
25	Copper(Cu)	mg/l	AAS, Flame	391.4	407.0	0.54	0.50	0.53	0.53	0.04	0.19	<0.04	<0.04	0.05	0.2*
26	EC	µS/cm	EC meter (determined on-site)	1120.0	1110.0	610.0	590.0	630.0	610.0	680.0	700.0	610.0	580.0	None	300*
27	Water Temperature	^{0}C	Thermometer (determined on-site)	26	26	21.5	21.5	26.0	22.0	27.0	27.0	26.5	26.0	-	-
28	Air Temperature	^{0}C	Thermometer (determined on-site)	31	31	31	31	29.0	29.0	31.0	31.0	31.0	31.0	-	-

NOTE: Standards are based on DENR Administrative Order # 34 (Class C – intended uses are for Fishery, Recreation and Industrial ; Class D – for Agriculture/Irrigation)
* - Based on Guidelines for Interpretation of water quality for irrigation, Wastewater Engineering

Table 3.4.2 Results of Bed Material Quality Survey for Mapanuepe Lake and Reservoir of Dizon Mine Tailing Dam

ITEM NO.	*LABORATORY TEST ITEM*	*UNIT*	*METHODS OF ANALYSIS*	*Sampling Location/Results*				
				Dizon Mining Dam	Mapanuepe Lake			
				A. Reservoir Area	B. U/S near Dam	C. Central area	D. D/S near channel	E. Inlet area
1	Organic Carbon	mg/kg	Blak& Walky Method	1,200.0	1,200.0	1,200.0	4,100.0	7,600.0
2	Total Nitrogen	mg/kg	Kjeldahl	285	284	443	354	308
3	Total Phosphorous	mg/kg	Colorimetric	8.2	1.53	1.19	2.86	46.4
4	Total Sulfur	mg/kg	Colorimetric	376	276	328	604	124
5	Mercury	mg/kg	Cold Vapor AAS	5.19	1.31	5.47	1.65	1.58
6	Zinc	mg/kg	AAS	70	41.6	67.8	46.4	111
7	Lead	mg/kg	AAS	32	27.5	31.5	9.9	27
8	Copper	mg/kg	AAS	271	120	172	486	382
9	Hexavalent Chromium	mg/kg	Colorimetric	<0.025	<0.025	<0.025	<0.025	<0.025
10	Cadmium	mg/kg	AAS	<0.003	<0.003	<0.003	<0.003	<0.003
11	Arsenic	mg/kg	Colorimetric	1.37	1.13	1.11	<0.01	0.03
12	pH	-	Gas Electrode	6.73	4.21	3.47	6.27	6.87
13	Iron	mg/kg	AAS	15,000.0	15,500.0	20,500.0	15,900.0	12,800.0
14	Manganese	mg/kg	AAS	566	174	351	204	1,952
15	Calcium	mg/kg	AAS	1,700.0	1,000.0	2,200.0	2,200.0	2,300.0
16	Magnesium	mg/kg	AAS	2,200.0	1,900.0	2,200.0	1,700.0	1,800.0