8.3 Forecasting and Warning System Strengthening Project

8.3.1 Present Condition of Forecasting and Warning

The identified hazard in the Study Area are:

- Typhoon,
- Eruption of volcano,
- Flood and inundation and
- Mud and debris flow

Typhoon is monitored by the PAGASA availing global meteorological information to be provided by the international meteorological networks together with domestic weather data observed mainly by themselves. The data and information applied and forecasting method adopted in the forecasting are one of the most updated ones. The strengthening thereof might not be so effective unless global strengthening is attained.

The PHIVOLCS is responsible for monitor and issue warning to the local government if the volcano indicates any sign of eruption. The methods adopted to monitor the volcano are as follows:

- Seismograph at 4 sites:
- Analysis of SO_2 concentration :
- Deformation of mountain slope by EDM:

The identified problems with regard to the installed seismograph are:

- Only one element is observed:
- The maximum period to be detected is 1 second:
- The observation is concentrated to south to east:
- The observed seismic wave is recorded by pen plotter;

Meanwhile the existing SO_2 gas analyzing method has problems as follows:

- Sampling site is not fixed
- Estimation of deformation on the basis of the EDM data takes a considerable time and recursive estimation with short interval might not be afforded.

Rainfall and river water level data are fundamental to forecast flood and inundation. The PAGASA established climatologic observatories in each municipality to observe meteoro-hydrologic conditions in the Study Area. The problems of the observation are as follows:

- Observation of rainfall is manual with 3 hours interval at shortest.
- The locations of the observatories are low lying urbanized area
- No regular water level observation is conducted in the Study Area

Regional OCD has managed mud and debris flow monitoring system. The system comprises 5 telemetered rainfall gauges and 4 wire sensor systems. The problems thereof are as follows:

- The lead time to be afforded by wire sensor system is only a few minutes
- The observed site is limited to south slope
- Forecasting model does not adapt to the site conditions

PAGASA, PHIVOLCS and DPWH are the member of PDCC, CDCC and MDCC. The information or forecast made by the central offices thereof are relayed to ROCD, PDCC, CDCC and MDCC. The warning is duly relayed to BDCC from relevant MDCC and CDCC.

8.3.2 Basic Concept

The candidate systems for the priority project are those selected systems in the proposed Master Plan. The selected systems from those proposed in the Master Plan constitute the forecasting, warning and evacuation system of the proposed feasibility plan. The criteria adopted to assess the candidate system to select into the feasibility plan are as follows:

a) Technical reliability (accuracy in forecasting and reliability in warning)
Accuracy and reliability should be sufficient for evacuation and disaster fighting activity

b) Compliance to needs (lead time and quick response)
Since the system is to furnish a reliable information for evacuation and disaster fighting activity, the system should afford sufficient lead time with quick judgement for those activities.

c) Availability (existing infra-structure and system)
The proposed system should adapt to the existing local conditions, the existing infra-structure and system should avail the existing resources as much as possible.

d) OMR (OMR cost and manpower)
In order to secure sustainability, OMR cost and manpower input should be minimized

e) Durability (natural circumstance)
The proposed system should be available in a critical Circumstance and be durable against site conditions.

f) Economic aspect (cost and space)
Disaster prevention reduce damage value but does not produce any positive economic value and lesser cost and space are preferable.

In the light of the criteria, the following systems were selected as the priority project:

(1) Forecasting and warning for volcanic eruption (PHIVOLCS)

1) Monitoring

a) Telemetered seismograph : 7 stations. 4 existing (Mayon Resthouse, Upper S.Misericordia, B.Anoling, Lignon Hill) and 3 additional (B.Canaway, Upper B.Muladbucad Grandei and U.Banadero)

b) EDM and GPS : Existiong EDM and additional GPS (4 directions at about …El. 800m)

c) Gas analysis : Existing: Collector and analyzer

2) Judgement

a) Analysis of seismic wave : Amplitude, frequency and time of travelling of seismic wave.

b) Analysis of SO_2 : Concentration of SO_2 in air

c) Assessment of internal pressure : The FEM analysis on slope deformation

3) Warning

a) Judgement and decision making : PHIVOLCS head office in Manila

b) Transmission of warning : PHIVOLCS observatory in Lignon hill transmits the decision made by the head office to CDCC and MDCC through VHF and the public telephone line. Warning is relayed to ROCD and PDCC as well.

(2) Forecasting and warning for flood, inundation and mud and debris flow (DPWH)

1) Monitoring

a) Tele-metered rainfall gauge : Existing : 5 (B. Maninila, B.Mabinit, B.Buyuan, B.San Antonio and Mayon Rest House)
: Additional : 9 tele-metered gauging stations tallying 14 stations to observe the rainfall in the slopes of the mountain.

b) Tele-metered water level gauge : New : 6 (Yawa, Quinali B, San Vicente, Nasisi, Oguson, Quinali A)

c) Tidal level gauge : Legaspi port

2) Judgement

Flood

a) Analysis of water level : Water level at strategic site and down stream reach

b) Runoff analysis : Measured rainfall

Mud and debris flow

a) Analysis of measured rainfall : Accumulated rainfall and intensity of rainfall

b) Standard for judgement : for watch and evacuation

3) Warning

a) Judgement and decision making : DPWH region Ⅴ

b) Transmission of warning : DPWH region Ⅴ transmit warning to CDCC and MDCC. Warning is relayed to ROCD and PDCC as well.

(3) Forecasting and warning for typhoon

1) Monitoring (ongoing method)

a) Satellite : GTS and GMS

b) International information : RSM and TYM

2) Judgement (ongoing method)

a) Map : Meteorological map

b) Chart : Weather chart, atmospheric pressure chart and typhoon track forecasting chart

3) Warning

a) Judgement and decision making : PAGASA head office in Manila

b) Transmission of warning : From PAGASA manila to Legaspi observatory by SSB
From the observatory to CDCC and MDCC by VHF. Warning is relayed to ROCD and PDCC as well.

(4) Warning dissemination

1) Main route : Agencies to M/CDCC by VHF radio
M/CDCC to BDCC by cellular phone
BDCC to each family by house to house Visit

2) Other route : PDCC to mass media

(5) Inter-agency disaster information system (ROCD) : WEBB server system in PDCC, DPWH, PHIVOLCS, PAGASA, MDCC, CDCC, and ROCD

8.3.3 Preliminary Design of Proposed System

(1) Objective of preliminary design

A preliminary design is to confirm the technical feasibility of the proposed forecasting and warning system. The systems, the technical feasibility to be confirmed are seismographic telemetering system, rainfall gauging telemetering system and water level telemetering system because the local conditions affect these proposed systems and the confirmation of the applicability of these core system are necessary. The feasibility of other systems such as VHF radio communication system are already confirmed in the site or any other sites and the effects of local conditions are deemed not significant.

The main subjects discussed are sensor, communication facility, data processing system.

(2) Sensor

1) Seismograph system

The priority project proposes the strengthening of seismograph system to monitor the activity of the volcano. As discussed in the previous chapter, strengthening

and improvement of the existing sensor are necessary. The main improvements are:

- detect the wave with longer period (10 sec. or more)
- detect the horizontal wave in addition to vertical one
- detect at the west and north slopes
- detect at the site with a high altitude

The proposed plan is to install seismographs at:

- S5 Upper Canaway (north) EL.400
- S6 Upper Mabinit (south) El.1500
- S7 Upper Muladbucad Grandai (west) El.400

The specifications of the proposed seismograph are,

- velocity measurement
- frequency of wave: 0.05 to 100
- maximum period of wave: 20 second
- 3 element per site

The locations thereof are shown in Figure 8.3.1 together with radio circuit plan for telemetering.

2) Rainfall telemetering system

The strengthening of rainfall telemetering system contribute to the improvement of the flood and inundation forecasting and mud and debris flow forecasting. As mentioned in the previous chapter, some improvements in the existing system are necessary. They are:

- The existing rainfall gauges are concentrated in the southern area and the installations in other area are necessary to cover all the substantial drainage areas
- Installation of the existing gauges does not reflect the spatial distribution of rainfall. A rainfall gauge may represent the rainfall in the surrounding area within a radius of 2.67km with an error of less than 10%

The proposed sites for installation are,

- P6 upper Santa Misericordia
- P7 DPWH region V
- P8 Matnog
- P9 Bahag (water level/rainfall)
- P10 Upper Muradbucad Grandei

- P11 Nasisi (water level/rainfall)
- P12 Buang
- P13 San Vicente (water level/rainfall)
- P14 Upper Canaway

The locations thereof are indicated in Figure 8.3.2 together with radio circuit plan for telemetering.

The specifications of the proposed rainfall telemetering system are,

- tipping bucket
- event reporting type
- event: 1mm
- maximum intensity 200mm/hour

3) Water level telemetering system

For the time being, no river water level is observed in the regular basis. The measurement of river water level is necessary to forecast flood and inundation. The hydrologic and river engineering study identified rivers liable to flood. The Study identified that Legazpi city is inundation prone area due to poor drainage system to be affected by tide.

The identified rivers are the Yawa, Nasisi, Ogsongg, San Francisco Quinali(B) and SanVicente rivers. The Study identified a strategic key point for each river to monitor the fluctuation of the water level. The proposed water level gauges are to be installed at those key points. They are,

- W1 Yawa Bahag
- W2 Nasisi Nasisi
- W3 Ogsongg Paulog
- W4 S. Francisco Cavasi
- W5 Quinali(B) Ogob
- W6 S.Vicente San Vicente
- T1 Port Legazpi port (tidal gauge)

The locations thereof are illustrated in Figure 8.3.3 together with radio circuit plan for telemetering.

The proposed specifications are,

- floating type durable for sand and gravel flow
- minimum scale 1.0 mm
- poling type telemeter
- minimum poling interval: 10 minutes

(3) Design of data transmission network

The existing telemetering systems for seismograph and rainfall are using UHF radio with a frequency of 400 MHz band. The strengthening system should adapt to the existing ones. The proposed additional gauging sites are 24 which are distributed in the surrounding area of the volcano. Accordingly, some waves allocated to gauging stations might be availed to ones on the other side of the volcano. The consequent numbers of waves might be around 15 waves which is considered to be allowable number of wave allocation. Along this line the feasibility plan constitute the communication net works with UHF with a frequency band of 400 MHz.

The proposed networks comprises two subsystems, the seismograph system and rainfall and water level system. The supervisory control unit of the former system is located in the PHIVOLCS observatory at Lignon hill. While DPWH region V office is the site for the supervisory control units for rainfall system and water level system. The existing repeater stations in Ligao and Mayon rest house are available for both subsystems .

In order to carry the data collected at northern slope of the volcano within two spans, a new repeater station is provided on the east slope of the volcano. The repeater site is Santa Misericordia. The data of U. Canaway seismograph is to be sent to Lignon hill via the repeater station. The data of U.Canaway rainfall gauge is to be sent to DPWH Region V via the repeater station.

The existing system proved that S/N ratio of 30 dB or more under the condition of fading provide sufficient data transmission quality. The margin against confidence limit of 10 dB or more is necessary according to the experiences.

The necessary antenna output for each station and the required number of circuit wave were studied under the following assumptions and procedure:

1) Assumptions

The existing system attested the availability of Yagi antenna with five elements for transmission and Brown for receiver.

The frequency of the circuit wave is 400 MHz.

The existing system attested the availability of antenna pole with an antenna height of 10 m.

The S/N ratio of the proposed circuit must be 30 dB or more under the condition of fading.

The margin against confidence limit of the proposed circuit must be 10 dB or more.

2) Modeling

Model for S/N ratio

The S/N ratio under fading is given by the following formula:

S/N = x + G1 – L1(1) ..... (1)

Where x : antenna output
G1 : antenna gain(Ag), Circuit improvement(Ig), Gain by noize(Ng)
L1 : free space loss(Sl),topographical loss (Tl), antenna loss(Al), fading loss(Fl)

Model for margin

Margin against the confidence limit is given by the following formula:

M = x + G2 – L2 ..... (2)

Where x : antenna output
G2 : Ag, confidence limit(Cg)
L2 = L1: Sl, Tl, Al,Fl

3) Gain and loss

Antenna gain (Ag)

Ag = Ag(t) + Ag(r)

Where Ag(t) = 11.0 dB(5 element Yagi)
Ag(r) = 2.1 dB(Brown)

Accordingly Ag = 13.1 dB ..... (3)

S/N improving factor (Ig)

Assuming 70% modulation, Ig = 1.3 dB ..... (4)

Receiving noise gain (Ng)

Comprises internal and external noise, Ng = 120.0 dB..... (5)

Free space loss (Sl)

Sl is given by the following formula:

Sl = 20logf + 20logD + 32.4 ..... (6)

Where f : frequency in MHz
D : span length in Km

Topographic loss (Tl)

In case topographic profile has sufficient clearance against the 1st Fresnel zone, loss is nil. If the clearance is not sufficient, the loss due to knife edge and loss due to shading are accounted for.

Where the depth of the Fresnel radius is given by

$$R = \{ 0.72d1*d2/(d1+d2) \}^{0.5}$$

Antenna loss (Al)

Transmitter and receiver power line losses, coaxial cable loss and other loss. Power line loss is estimated by the ratio of 0.11dB per meter .

Coaxial cable loss = 0.4
Other loss = 3.0

Assuming the cable length to be 20m, the loss is estimated to be

A1 = 7.8 dB

Fading loss (Fl)

Fading loss is obtained by the following formula:

$$F1 = 0.2D + 3 \quad \text{.....} \quad (8)$$

Where D : span length in km

Confidence limit (Cg)

Confidence limit is given by the following formula:

$$Cg = Ng + Ig - 30$$
$$= 91.3 \quad \text{.....} \quad (9)$$

4) Criteria for circuit design

The formula and figures obtained in the previous paragraph, G1,G2,L1 and L2 are simplified as follows:

G1 = 134.4 dB
G2 = 104.4 dB
L1 = Sl+Tl+Fl+7.8
= L2

The design criteria are,

$$S/N \geq 30dB \text{ and}$$
$$M \geq 10\ dB$$

Accordingly,

$$X \geq Sl+Tl+Fl - 86.6\ (dB) \quad \ldots\ldots (10)$$

Where Sl, Tl, and Fl are specific to each span. The antenna output (x) should be so designated to satisfy the equation (10).

5) Antenna output and necessary power

Terrain profiles were developed for each span on the basis of the topographic map in a scale of 1 to 33,000. Sl and Fl can be obtained by formula (6) and (8). The Fresnel zones depicted indicate that losses due to shading should be accounted in The spans of S5-R3, P14-R3, R1-Lignon hill and R1- DPWH region V. The estimated losses are 8.5dB, 8.5 dB, 4.5dB and 5.2 dB respectively on the basis of the chart shown in Figure 8.3.4. The total of Sl, Tl and Fl are summarized in Table 8.3.1.

The obtained max. mini of X was 36.1 dB for the span R1-DPWH region V. Next to the span, X for the span R1- Lignon hill is 33.7 dB, the second largest. Xs of other spans are less than 30 dB.

Antenna output X is given by the following formula:

$$X = 20 \text{ Log } w + 30$$

Where w : power in watt

The necessary transmission power for each station was estimated on the basis of minimum antenna output estimated. The results of the estimation are as follows:

R1 to Lignon hill : 3 watt
R1 to DPWH : 5 watt
Others : 1 watt

Since R1 is the existing Ligao repeater station, public electricity is available. Other stations may be located in the remote area but the necessary power is 1 watt and solar system can be availed for power source. The estimated necessary powers are summarized in Table 8.3.2.

The proposed radio circuits for telemetering systems of seismograph, rainfall gauging and water level gauging are shown in Figures 8.3.1 to 8.3.3 respectively.

6) Necessary number of wave

As of now, 10 waves are utilized in the Study Area. They are mostly allocated to the stations located in the southern slope. They are consequently available for the stations located on the northern slope again. The allocation of wave were examined span by span. According to the result of the wave allocation study, 15 more waves are necessary as shown in Table 8.3.3.

(4) Design of data processing system

1) Volcanic eruption forecasting

PHIVOLCS Manila has carried out the forecasting on the basis of the data obtained at the Lignon hill observatory and other environmental information. At the observatory, the main work is to detect the abnormal activity of the volcano on the basis of the observed seismographic data. Other data processing at the observatory is preliminary data arrangement to send the data to Manila.

Accordingly the data processing system required to the observatory should have functions of supervisory control of telemetering system, graphic display of the obtained seismic wave to monitor and to compilation of a digital data file to attach E-mail. The proposed processing system comprises a control unit, a processing unit, a graphic terminal, a printer, and external storage like a DAT.

2) Mud and debris flow forecasting

The data processing unit should have functions to control telemetering system, forecasting the occurrence of mud and debris flow, issuing warning and data recording. The main component of the data processing system are the supervisory control unit of telemetering system, data processing unit, graphic terminal, printer and external memories.

The highlight of the job of the data processing is the forecasting of the occurrence of mud and debris flow. The forecasting is carried out on the basis of the measured rainfall data and possible future rainfall.

Critical Line

In order to judge the occurrence the critical line of rainfall was developed on the basis of the rainfall records which triggered mud and debris flow in the Pawa-Burabod river and the Padan river as follow:

$$Y = -0.03x + 11.3 \quad \text{.....} \quad (1)$$

Where Y : mean rainfall intensity in mm/hour

X : cumulative rainfall depth in mm

The developed model (1) indicate that a rainfall with the mean intensity larger than Y for the measured certain cumulative rainfall X has a high possibility to cause mud and debris flow. The proposed critical line and the plotting positions of the recorded rainfalls are depicted on Figure 8.3.5.

Warning and Lead Time

As mentioned in the previous paragraph, a rainfall to be plotted in the upper zone from the developed critical line in the chart has a high possibility of causing mud and debris flow. The issuance of warning should be prior to such situation by means of forecasting to afford the time for disaster preparedness to the people at risk. The necessary lead-time for warning depends on the required time for preparedness.

The system for the preparedness such as organization, communication, transportation and the physical conditions of the site might be imperative to define the required time against disaster. The system should be so designed as to require the shortest time for preparedness with the highest reliability because the accuracy of forecast become higher if the lead time is shorter. The activities for the preparedness were staged in accordance with roles, responsibilities and lapse time is shorter.

Stage I : Staff of OCD and DPWH in charge should stationed at the weather monitoring offices to watch and wait further development for 24 hours by 3 shifts.

Stage II : Warning should be issued addressed to officials and residents at risk for their preparation works. Warning should be released to mass media. MDCC/CDCC and BDCC should commence the preparatory works to execute the disaster management plans. Residents at risk should prepare for evacuation. DPWH should prepare to execute SOP and dispatch inspection teams to the strategic site to monitor the situations of infrastructures.

Stage III : Warning should be issued to all the concerned people, through official routes and mass media because the occurrence of disaster is highly possible. MDCC/CDCC and BDCC should execute their disaster management plan.

Residents at risk should evacuate to the evacuation center DPWH should execute SOP.

Stage IV : Release should be issued to all the concerned people. All the people and officials may resume the normal activities.

The preliminary study on the required time for the activity of each stage tentatively concluded as follows:

Stage I : Warning level 1 (WL-1), 1 hour

Stage II : Warning level 2 (WL-2), 1 hour

Stage III : Warning level 3 (WL-3), 2 hours

Stage IV : Warning level 0 (WL-0), -

The subsequent tentative necessary lead times for warning are as follows:

WL-1 : 4 hours

WL-2 : 3 hours

WL-3 : 2 hours

WL-0 : after no occurrence of disaster is confirmed (after one shortest dead time of 12 hours)

The assumed lead times indicate that each level of warning should be issued so many hours in advance of the occurrence of a disaster. For instance warning of level-2 (WL-2) should be issued 3 hours before the occurrence of disaster.

Warning Line

As discussed before, a mud and debris flow occurs when the plotting position of a rainfall reached to the critical line in the chart presented in Figure 8.3.5. Accordingly, the locations of the plotting position obtained from the critical line Less the forecasted 3 hours rainfall defines the line for warning level 2. The developed formula to define the warning line is as follows:

$$Y = \frac{aX^2 + (b + ax_{mt} - ax_1)\,X - (b + ax_{mt})x_1}{(1\text{-}a.tl)\,X - x_1 + x_{mt} - (b+ax_{mt}).tl} \quad \text{.....} \quad (2)$$

Where
- Y : y value of warning line with a lead time of tl.
- X : x value of warning line with a lead time of tl.
- a : slope of critical line given by equation (1) -0.03
- b : y- intercept of critical line given by equation (1) 11.3
- tl : lead time in hour 4, 3 and 2 for WL-1, WL-2 and WL-3 respectively
- x_1 : initial rainfall to start accumulation in mm
- x_{mt} : assumed maximum rainfall for 1,2 and 3hours: 156, 141 and 107mm for WL-1, WL-2 and WL-3 respectively

The tl for each warning level might be fixed as assumed until new required lead time is obtained. While x_I will vary from event to event. The assumed X_{MT}S are the recorded maximum rainfall depth occurred on January 5 to 7, 1994. Those maxima were recorded at the same event. In order to secure the safety of disaster preparedness, the adoption of the recorded maxima is recommendable because recurrences of the maxima are provable.

The level zero warning can be issued 12 hours after the subsidence of rainfall because the dead time is set at 12 hours. However, a deliberation on PAGASAs weather forecast is necessary prior to the decision making on the issuance of the release. It is possible that weather threatens the area again after 12 hours dead time.

The warning line was developed applying the recorded maximum rainfall and the consequent warning lines become low, which tends to produce an alarm with small rainfall. Further, the warning lines start from zero total effective rainfall with negative y value which mean any effective rainfall cross over the warning line. Y value become positive when total effective rainfall become around 15 mm.

Meanwhile the recorded maximum rainfall reached that high intensity 6 to 7 hours after the commencement of the event. The accumulated effective rainfall at 5 hours before the occurrence of the recorded maximum 4-hour rainfall is 20mm on Jan. 6, 1994 at 8 o'clock in the morning. Further the minimum accumulated effective rainfall at 5 hours before the occurrence of mud and debris flow is 35.5

mm in the case of March 3, 1996. So, it is tentatively concluded that the warning lines are to be applied after the accumulated effective rainfall reaches 20mm.

The example of the warning lines are shown in Figure 8.3.6.

3) Flood forecasting

The data processing system for flood forecasting will be installed in the DPWH Region V to issue warning to the local government. The substantial functions of the system is to control the telemetering system of water level, forecasting of the occurrence of flood, issuance of warning and recording of the collected data. Accordingly the proposed data processing system comprises a control unit, a processing unit, a graphic terminal, a printer, and external storage like a DAT.

The highlight of the job of the data processing is the forecasting of the occurrence of flood. The forecasting is carried out on the basis of the measured rainfall data and water level at the strategic points.

Lead Time for Forecasting and Warning

A timely warning affords time to residents and agencies to prepare against the impeding flood. Residents might evacuate carrying their valuables. Agency might respond in line with their disaster preparedness plans. Measurement of the necessary times for those activities are yet to be done in the occasion of actual disaster. So far the necessary times are assumed on the basis of hearing surveys as follows:

Residents	Preparation for evacuation	:	1 hour
	Evacuation		2 hours
Agency	Preparatory works	:	1 hour
	Mobilization	:	1 hour
	Stationing of monitoring team	:	1 hour

Along this line, 3 levels of warning might be necessary for the disaster prevention activities as summarized in the following table.

Lead Time and Activity by Warning Level

Warning Level	Lead time in hour	Activities Resident and CDCC	Agency (DPWH)
1	4	-	Station by 3 shifts at the monitoring office. Watch and wait further development. Preparatory works to issue second level warning.
2	3	Preparation of evacuation	Issue second level warning to PDCC, MDCC/CDCC and media. Dispatch inspection team to the strategic point of structures. Preparation of emergency response Preparatory works to issue third level warning.
3	2	Execution of Evacuation. Management of Evacuation center	Issue 3rd level warning to PDCC, MDCC/CDCC and media. Execution of emergency response.
0	-	Resume normal Activities	Issue zero level warning to PDCC, MDCC/CDCC and media. Withdraw the emergency response facilities and resources and resume normal activities.

Critical Line

Phase – I study have selected strategic sites for water level measuring for hazardous the six rivers in the Study Area. The sites are the most vulnerable or representing point of each river. The river water levels at the selected points might be possible to indicate the occurrence of the flood.

Dikes are provided at the banks of the selected site. The height of wave due to winds and hydraulic dynamics during flooding is assumed to be 70 cm. In this consequence, the adopted critical water level turned to be 70 cm below the top of the river bank. A water level of the stream higher than the critical water level has high possibility to overtop the bank and cause flooding.

Warning is to be issued when the river water level is predicted to exceed the adopted critical water level.

Forecasting algorithm for future water level

a. Most likelihood forecast

As mentioned in the previous sentences, the proposed system measures real time rainfall and water level. The measuring interval of rainfall is deemed to be zero because event report type telemetering system is proposed.

The interval of water level is 60 minutes for ordinary case but could be shorten to 15 minutes at critical case because poling type telemetering

system is proposed. Consequently the most likelihood estimation for the forecast of discharge at t- hour later is given by the following formula:

$$q(T, t) = Q(T) + EN(T, t) + er \quad \text{.....} \quad (3)$$

Where
- T : The time when the forecast is done
- t : Lead time of forecast
- $q(T, t)$: Forecasted discharge for time $T + t$
- $Q(T)$: Measured discharge at time T
- $EN(T,t)$: External noize affects the system during the period between the times T and $T + t$.
- er : Error distribute in accordance with the standard normal distribution N (0,1)

The proposed water level telemetering system furnish real time Q (T) through working out the relevant water stage – discharge curve to be established. Er might be assumed zero because the expectation thereof is zero.

Meanwhile, the substantial element of EN (T, t) is runoff corresponding to the rainfall received before T. Or more accurately, the difference between the runoff at time T and time $T + t$.

b. Estimation of runoff

There are several method to estimate runoff on the basis of the received rainfall. Most of the methods require calibration using the recorded rainfall and runoff. The runoff record is not available in the Study Area and a hypothetical linear response function (Nakayasu Method) is applied. The method is expressed by the following formula:

$$t_g = 0.26\, L_m^{0.7}$$

$$T_1 = t_g + 0.8\, t_r$$

$$T_{0.3} = 3.0\, t_g$$

$$Q_{max} = AR/\{3\,(0.3\,T_1 + T_{0.3})\} \quad \text{.....} \quad (4)$$

$$Q_a = (t_t/T_1)^{2.4}\, Q_{max} \quad \text{.....} \quad (5)$$

$$Q_d = 0.3^{(t-T_1)/T_{0.3}}\, Q_{max} \quad \text{.....} \quad (6)$$

Where
- t_g : Time of concentration (hour)
- L_m : Average distance in km from watershed area to channel (km)
- T_1 : Time of peak runoff (CMS)
- T_r : Duration of rainfall accumulation

(10 minutes)

$T_{0.3}$: Time when the runoff become 30% of the peak (hour)

A : Catchment area (km^2)

R : Accumulated rainfall (mm)

Q_{max} : Peak runoff (CMS)

Q_a : Runoff in the ascending period (CMS)

Q_d : Runoff in the descending period (CMS)

t_t : Lapse of time

In this Study, all the L_ms are less than 10 km and t_gs are to be assumed between 0.5 ~ 1.5 hour. Consequently, the following constants might be adopted:

T_g = 60 (minutes)

T_1 = 70 (minutes)

$T_{0.3}$ = 180 (minutes)

Working out formula (4), (5) and (6), runoff of each 10 minutes is obtained applying linear interpolation.

c. Filtering

The formula (3) indicate that q(T-1,1) is the most likelihood estimation of Q(T). The difference between the measured Q(T) and estimated Q(T) represent the adaptability of the adopted forecasting moded, formula (3). In order to enhance the accuracy of the forecast, the adjustment factor C is introduced by the means of filtering as follows:

$$C = \frac{Q(T) - q(T-1, 1)}{Q(T)} \quad \text{..... (7)}$$

Where C : Adjustment factor of forecast

The consequent forecasting model is presented as follows:

$$q(T,t) = \{ Q(T) + EN(T, t) \} (1 + C) \text{..... (8)}$$

4) Issuance of warning

Disaster preparedness requires a certain time as mentioned in the former paragraph. The lead time necessary for warning levels of 1, 2 and 3 are 4, 3, hours. Accordingly, warning of each level should be issued as follows:

Warning level 1 : When the estimated water level corresponding to q(T,4) exceed the critical water level

Warning level 2 : When the estimated water level corresponding to q(T,3) exceed the critical water level

Warning level 3 : When the estimated water level corresponding to q(T,2) exceed the critical water level

Warning level 0 : When the estimated water level corresponding to q(T,6) do not exceed the critical water level

5) Inter Agency Disaster Information System

The proposed system is WEB server system links ROCD, PAGASA, PHIVOLCS, DPWH, PDCC, CDCC and all the MDCCs. ROCD is responsible to maintain the system including WEB server unit. All the agencies linked by the network shall be provided a PC with peripheral units and MODEM to avail mail system.

8.4 Evacuation System Strengthening Project

The residents of the Study Area are usually threatened by the following hazards: pyroclastic flow, lava flow and ash fall (due to eruption of the Mayon Volcano) , flood, inundation and mud and debris flow (caused by heavy rainfall) and strong wind (due to typhoon). Hence, the Study Team has identified evacuation-oriented coping strategy as one of the possible countermeasures which will enable the affected residents to better cope with the effects of such hazards . The strategy will involve the designing of evacuation centers that will consider the type of hazard that will affect the community and will ensure the safety and comfort of the evacuees during their stay there. It will also entail strengthening of the present evacuation system that will be carried out based on a clear and detailed understanding of the disaster threat particularly on the part of the residents.

(1) Purpose of the Project

- To protect human lives from hazards

(2) Basic Design Condition

1) Time Required for the Evacuation by Hazard

- Mayon Eruption
  The evacuation plan should be able to facilitate the transfer the residents of the affected areas to the evacuation centers or safe areas within 24 hours upon the issuance of the Alert Level 3 by the PHIVOLCS.

- Mud and Debris Flow
  The evacuation plan should be able to facilitate the transfer of the residents of the affected areas to the evacuation centers or safe areas within 2 hours upon the issuance of Warning Level 3 by the DPWH and ROCD.

- Flood and Typhoon
  The evacuation plan should be able to facilitate the transfer of the residents to the evacuation centers or safe areas within 3 hours upon the issuance of Warning Level 3 of PAGASA.

2) Procedures

- The timely issuance of warning and the subsequent evacuation can be effected with the installation of appropriate equipment designed to

provide information on the occurrence of volcano eruption, mud and debris flow, typhoon and flood.

- The strengthening of the capability of the PDMO in acting as the communication center between the agencies issuing the warning (PAGASA, PHIVOLCS, ROCD) and advisories to the affected municipalities and cities.
- The provision of the means of communication between the C/MDCCs and the BDCCs.
- Improvement of the coping mechanism of the community through the conduct of regular disaster awareness and preparedness programs. A concrete example is the conduct of regular drill on specific hazard to improve the disaster prevention capabilities of the local people.
- Improvement of the capability of the BDCCs in the performance of evacuation-related tasks.
- Preparation and updating of Disaster Preparedness Plans at the BDCC level.

3) Organization and Staffing

At all levels of DCCs, there is a Committee on Evacuation that is tasked with matters related to ensuring the safety of the affected residents at times of disasters. The tasks of each member of the said Committee on Evacuation are already clearly stated. What is more important is enhancing the capabilities of the members to perform their tasks to prevent loss of lives during disasters.

4) Facilities

a. Basic Concepts

- The existing evacuation centers are expanded to accommodate the evacuees.
- The facilities of the existing evacuation centers are enhanced to provide a more comfortable accommodation for the evacuees.
- The provision of emergency shelters to those who may have lost the opportunity to go to the evacuation centers.
- The provision of livestock sanctuaries to give protection to the livestock of the evacuees.

b. Criteria for Planning

- Standard area for evacuation center is 3.52m^2 per person
- Standard number of toilet facilities in evacuation center is 1/25 persons

- Standard number of faucets in evacuation center is 1/50 persons
- Standard number of shower facilities is 1/50 persons for evacuees during the volcano eruption
- Standard number of emergency shelter is one per major river basin
- Standard number of livestock sanctuary is one per municipality

5) Facility Planning

a. Evacuation Centers

Coverage of each evacuation center

There are initially 56 evacuation centers (school buildings) in the Study Area that are recommended to be improved during the priority project implementation (Figure VIII 4.1 Supporting Report (1)). These will cover the following barangays:

Barangays with the Evacuation Center

Municipality	Barangay
Bacacay	Lower Bonga, Hindi, Bayombong, Bgy. 12 Poblacion, Sogod
Camalig	Ilawod, Libod, Ligban, Salugan, Tagaytay, Poblacion
Daraga	Busay, Alcala, Kilicao, Malabog, Malobago, Matnog, Binitayan, Budiao, Culiat, Tagas
Guinobatan	Upper Binogsacan, Dona Tomasa, Ilawod, Maipon, Maninila, Masarawag, Muladbucad Pequeno, San Rafael, Tandarora, Travesia, Bubulusan, Lower Binogsacan, Calzada
Ligao	Amtic, Baligang, Binanowan, Nabonton, Nasisi, Tambo, Tinago
Malilipot	Binitayan, Canaway, San Francisco, San Jose, San Roque, Sta. Cruz, Poblacion Bgy.2, San Isidro Iraya
Malinao	Awang, Balading, Balza, Cabunturan, Pawa, Payahan, Sta. Elena
Sto. Domingo	Fidel Surtida, Lidong, San Fernando, San Isidro, San Roque (Lower), San Roque (Upper), Sta. Misericordia, Sto. Domingo (Poblacion), San Andres
Tabaco	Bantayan, Bongabong, Bonot, Buang, Buhian, Comon, Mariroc, Oson, San Isidro, Baranghawon, Comon, Matagbac, Pinagbobong, Quinastillohan, San Antonio, San Lorenzo, San Roque, San Vicente, Tagas
Legazpi City	Arimbay, Bagong Abre, Bigaa, Dita, Bogtong, Bgy. 16, Washington East, Pawa, San Joaquin

Improvement of existing evacuation centers

The assessment shows that needed improvements must be undertaken so that the existing evacuation centers will meet the necessary standards as follows:

- provision of 3.52m^2 as absolute minimum space to an evacuee;
- provision of 1 toilet facility for every 25 individuals;

- provision of 1 faucet for every 50 individuals; and
- provision of 1 shower facility for every 50 individuals.

These improvements will necessitate the following:

- construction of 775 additional rooms (1 room=48m^2 for at total of 37,200m^2) in 56 schools located in the Study Area during the implementation of Phase I of the project;
- construction of 1,324 sets of toilet facilities;
- construction of 857 shower facilities in evacuation centers for volcano eruption evacuees; and
- water supply system with 929 faucets

The assessment of the evacuation system shows that there is a need to construct a total of 3,100 additional rooms to meet the space requirements of 148,990m^2 for the evacuees. The basis for this computation is as follows:

Estimated Population at Risk per Hazard

	Eruption	Flood/Mud and Debris Flow	Total
Estimated population at risk	60,980	16,383	77,363
Area required Standard: 3.52m^2/person	215,730	57,351	273,081
Estimated floor area of existing evacuation center (m^2)	87,763	32,864	120,627
Balance or area still required (m^2)	126,654	22,336	148,990
Faucets: Existing	87	79	166
Additional	834	95	929
Toilets : Existing	250	173	423
Additional	1,133	191	1,324
Shower facilities	857	-	857

The details of the computation are reflected in Table XIX 1.1 ~ XIX 1.10, Supporting Report (2).

However, it is being proposed that the construction of the target units be undertaken in four phases (Table XIX 1.11, Supporting Report (2)).

Phase I will mean the construction of the 775 rooms that will be undertaken in the 5-year implementation of the priority projects. The remaining balance (Phases II-IV) shall be considered for construction during the period of Master Plan implementation.

The construction of the additional rooms in the identified evacuation centers in Phase I is distributed as follows:

Construction of the Additional Rooms

City/Municipality	No. of Evacuation Centers	No. of Additional Rooms
Bacacay	3	23
Camalig	7	85
Daraga	7	63
Guinobatan	7	104
Ligao	4	49
Malilipot	7	111
Malinao	2	24
Sto. Domingo	3	39
Tabaco	10	161
Legazpi	6	116
Total	56	775

The proposed schedule of the construction for these additional rooms is as follows:

Schedule of the Construction of the Additional Rooms

City/Municipality	No. of Rooms/Year (Phase I)					
	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Bacacay	5	5	5	5	3	23
Camalig	17	17	17	17	17	85
Daraga	13	13	13	13	11	63
Guinobatan	21	21	21	21	20	104
Ligao	10	10	10	10	9	49
Malilipot	23	22	22	22	22	111
Malinao	5	5	5	5	4	24
Sto. Domingo	8	8	8	8	7	39
Tabaco	33	32	32	32	32	161
Legazpi City	24	23	23	23	23	116
Total	159	156	156	156	148	775

The detailed allocation of units per identified school in each city/municipality in Phase I is reflected in Table XIX 1.12, Supporting Report (2).

The construction of the toilet facilities and faucets is proposed to be completed during the implementation of the priority projects.

With the construction of new units to add to the existing ones, it is expected that positive change in accommodation for the affected families will be experienced at times of disasters. The prime considerations must be the safety and comfort of the evacuees.

When a disaster strikes, not all of the municipalities and barangays in the Study Area are affected and would require the evacuation of families. At such times, the concept of using inter-barangay or inter-municipality evacuation centers can be continuously adopted so that the required space per individual can also be attained. It means that the evacuees from the other municipalities can use the evacuation centers at the barangays and city/municipalities not affected by the disasters.

The proposed designs for the evacuation center, water supply, shower and toilet facilities are presented in Figures XIX 1.6 and XIX 1.7, Supporting Report (2).

b. Related Facilities

Emergency shelter

There are 16 emergency shelters being proposed to be constructed in each of the river basins around Mayon Volcano. There is a lot of agricultural activities in these areas since there are no alternative income generating opportunities available for the residents. These emergency shelters, each measuring 80m^2, are meant to provide protection to farmers who might not have the chance of going to their residences or to the evacuation centers when hazard strikes a particular area or areas. Made of concrete materials and provided with sirens, these are proposed to be constructed in elevated portion of the land. Each shelter can easily accommodate 50 persons.

Distribution of the Emergency Shelters

City/Municipality	No.
Bacacay	-
Camalig	2
Daraga	1
Guinobatan	2
Ligao	1
Malilipot	2
Malinao	-
Sto. Domingo	3
Tabaco	3
Legazpi City	2
Total	16

The design of the emergency shelter is presented in Figure XIX 1.8, Supporting Report (2).

Livestock Sanctuary

Providing temporary shelter to the animals is perennial problem of the evacuees. The construction of a livestock sanctuary per city/municipality (with the exception of Daraga) is being proposed. Made of semi-concrete materials and with some space for the grazing of animals, the sanctuary is proposed to be constructed in a 1,000m^2 lot to accommodate 300 animals (particularly the carabaos and the cows which are very important to the farmers) at one time. This space can easily accommodate 5% of the carabaos and cows and other small animals being raised in each of the city/municipality. The Socio-Economic Profile of Albay Province shows the following information regarding the average number of carabaos and cows in each city/municipality:

Average Number of Animals in Each City/Municipality

Animal	Average No. of Heads/City or Municipality	5% (for possible evacuation to the Livestock Sanctuary
Carabao	2,629	131
Cow	1,546	77

Hence, other small animals can also be very well accommodated in this sanctuary.

The livestock sanctuary is being proposed to be constructed in the following areas:

Proposed Livestock Sanctuaries by City/Municipality

City/Municipality	No.
Bacacay	1
Camalig	1
Daraga	-
Guinobatan	1
Ligao	1
Malilipot	1
Malinao	1
Sto. Domingo	1
Tabaco	1
Legazpi City	1
Total	9

The design of the livestock sanctuary is presented in Figure XIX 1.9, Supporting Report (2).

c. Communication System

- Evacuation center – each identified evacuation center must be provided with the VHF radio system with the same frequency as that of the P/C/MDCCs to maintain the necessary communication link at times of disasters
- Shelter – each shelter must be provided with a siren to facilitate the extension of the necessary warning signals to the local people in the farms and a battery-operated radio for them to know if the danger is over and the situation has returned to normal condition.

(3) Effective Use of the Facilities during Non-Hazard Times

a. Evacuation centers

Since the existing evacuation centers are mainly school buildings that will only be improved to provide the necessary accommodation to the residents at times of disasters, they can be used for their original purposes once the occurrence of disaster is over. The maintenance of such facilities will be the responsibility of the DECS.

b. Emergency shelters

As for the emergency shelters to be constructed to provide protection to the residents who are unable to go to the evacuation centers in the occurrence of hazard, their possible uses may include the following: trading posts for the agricultural products the local people, as an office of the agricultural extension workers, venues for the training and meetings to be conducted for the farmers or as rest areas for the farmers tilling the nearby farms. The LGUs should undertake the maintenance of these facilities.

c. Livestock sanctuary

These facilities can be used as demonstration farms or training centers of the City/Municipality Agricultural Offices during non-hazard times to improve the capability of the farmers on livestock raising.

(4) Work Volume

The estimated work volumes for the extension or enforcement of the existing facilities or new installation for Phase I are as follow:

Estimated Work Volumes for the Evacuation Facilities

Item	Unit	Nos.	Volume
Evacuation center	M2	56	37,200
- water supply (faucet)	Unit	929	929
- toilet	Unit	1,324	1,324
- shower facilities	Unit	857	857
Emergency shelter	M2	16	1,280b
Livestock sanctuary	M2	9	9,000

8.5 Resettlement Sites Development Project

In connection with the two priority structural projects selected in the Master Plan: Yawa River System Sabo Project and Legazpi City Urban Drainage Project, the issues of relocation and resettlement site development in the Feasibility Study pertain to Legazpi City (Banquerohan) and Daraga Municipality (Anislag). In principle, resettlement of the people is to be done within the respective administrative divisions (city and municipalities concerned) as confirmed in the key concepts for resettlement planning of Master Plan. As to their respective locations in the Study Area, refer to Figures 8.5.1 and 8.5.2.

Following the social development plans of each LGU concerned, the resettlement site development projects are designed to accommodate not only the Mayon victims but also "social poor". The following table indicates the number of target beneficiaries of the resettlement site development projects to be accommodated in Banquerohan (Legazpi City) and Anislag (Daraga Municipality).

Target Beneficiaries of the Resettlement Site Development Projects and Estimated Number of Relocatees

Items	Estimated No. of Households	Estimated Population
1. Total Number of the Target Resettlement Beneficiaries	1,695	8,984
- Banquerohan Resettlement Site (Phase I)	600	3,180
- Banquerohan Resettlement Site (Plan/ Phase II)	460	2,438
- Anislag Resettlement Site (Plan)	635	3,366
2. Number of the Estimated Relocatees due to Implementation of the Sabo and Drainage Projects *	(65)	(344)
- Pawa-Burabod Mabinit Sand Pocket *(To Banquerohan)*	*(44)*	*(233)*
- Anoling-Budiao Sand Pocket *(To Anislag)*	*(21)*	*(111)*
3. Legazpi City Urban Drainage Project *	(303)	(1,606)
4. Total Number of Relocatees *	368	1,950

Note: * The numbers of households and people to be relocated due to implementation of the sabo and drainage projects are included in the above total no. (No.1) of the target resettlement beneficiaries.

8.5.1 Present Condition and Problems

The profiles of the Banquerohan Resettlement Site and Anislag Resettlement Site Plan are given below.

Profiles of the Banquerohan Resettlement Site and Anislag Resettlement Plan

(as of November 1999)

Name	Banquerohan (Phase I)	Anislag (Plan)
1. Location	Banquerohan, Legazpi City	Anislag, Daraga Municipality
2. Distance from former residence (km)	20 km	8 km
3. Land area (ha)	Phase I: 18.93 ha (Phase II: 27.07ha)	21.35ha (Phase I: 12.57ha, Phase II: 8.78ha)
4. No. of houses	Phase I: 600 (Phase II: 460)	Planning for 635
5. Home lot size (m^2)	Phase I: 90-298m^2	100m^2 (10m x 10m)
6. House size (m^2)	Phase I: 20m^2 (4m x 5 m)	10.5m^2 (3.0m x 3.5m)
7. Establishment (year)	Phase I: 1994 (Phase II: Plan)	Construction started in 1998 for 80 units
8. Beneficiaries	Victims of Mayon eruption	Victims of Mayon eruption & typhoons
9. Actual no. of houses awarded	504 (No. of living households: 174)	Planning stage

Note: For more detailed information, refer to Table 8.5.1.

Source: Data from the City and Municipal authorities concerned and JICA

(1) Banquerohan Resettlement Site (Phase I)

The profile of Banquerohan Resettlement Site (Phase I) is shown in Table 8.5.1. From that given table and from the development plans furnished by the National Housing Authority (NHA) Region V, the site development conforms to the standards of the NHA for resettlement site and also to the "Batas Pambansa 220", which stipulates the development guidelines for development of relocation areas.

The Legazpi City implemented Phase I of the Banquerohan Resettlement Project located about 18km from the city proper. Of the 504 houses which were constructed, 46% of them (232) were not occupied due to lack of livelihood, 30 or 12.9% (30/232) were totally damaged by typhoons, and 202 or 87.1% (202/232) of the houses were partially damaged by typhoons and termites.

The following table shows the composition of resettlers by place or origin in Banquerohan Resettlement Site (Phase I) at the opening time in 1994.

Resettlers in Banquerohan Resettlement Site (Phase I)

Place of Origin (Barangays)	No. of Families to be Resettled (as of 1995)	No. of Families Occupied the Housing Units (as of 1995)	No. of Families Permanently Residing at Reset. Site (as of 1999)	Families Often Returned to Former Brgy. due to Livelihood	Families Not Residing at Reset. Site
1. Arimbay	1	1	1	0	0
2. Banquerohan	8	8	8	0	0
3. Bagong Abre	1	1	0	1	0
4. Bigaa	1	1	1	0	0
5. Bonga	141	132	41	91	9
6. Buyoan	54	49	24	25	5
7. Mabinit	148	123	49	74	25
8. Matanag	49	46	7	39	3
9. Padang	101	100	43	57	1
(Vacant Unit)	*(1)*	-	-	-	-
Total	504	461	174	287	43

Source : Legazpi City Social Welfare & Development Office.

(2) Existing Resettlement Plans (including Expansion Plans of the Existing Site)

1) Banquerohan Resettlement Site (Phase II)

The project profile of Phase II is also shown in Table 8.5.1. The concept for the development of Phase II site is to serve as production area for the whole Banquerohan Resettlement Site. A portion of Phase II area (8.8ha or 32.6%) is identified as area earmarked for agricultural purposes.

According to the Phase II development plan prepared by the NHA, the subdivision survey was already implemented by a local contractor. However, housing units are not yet constructed and the site is without power and water supply. About a fourth of Phase II is now being used by Phase I resettlers as their farm lots. Many of them plant vegetables and other cash crops.

2) Anislag Resettlement Plan

The land development for this resettlement site has already been completed based on the standards stipulated under “Batas Pambansa 220”. The resettlement area can only be reached from the main provincial road through the 1.5 km macadam access road. This access road is being used by both the resettlers and the residents living nearby.

The local government started constructing core housing units on some of the generated lots. Unit will be the counterpart share of the beneficiary. The material cost per individual unit is presently estimated to cost about PHP25,000 per unit.

The community facilities such as barangay hall, health and day care center, primary school and livelihood training centers are still absent.

The following table shows the number of project beneficiaries (No. of families to be resettled) in Anislag Resettlement Site.

Project Beneficiaries in Anislag Resettlement Site

(As of November 1999)

Place of Origin (Barangays)	No. of Families to be Resettled	%	No. of Certified Eligible Families*
1) Budiao	310	48.8	80 + 40 = 120
2) Banadero	21	3.3	-
3) Banag	69	10.9	-
4) Busay	94	14.8	-
5) Tagas	105	16.5	-
6) Binitayan	26	4.1	-
7) Anislag	2	0.3	-
8) Lacag	2	0.3	-
9) Kimantong	6	1.0	-
TOTAL	635	100.0	120

Note : * The families who were officially selected by Daraga SWDO for occupation of a housing unit in the Anislag resettlement site.

Source : Daraga Municipal Social Welfare & Development Office (DMSWDO)

To date, 80 house units have been constructed, and 80 households are listed for their occupation upon completion of the basic infrastructure works. Besides, construction of another 40 units is planned to start in early 2000.

(3) Problems Encountered

1) Socio-economic Problems

From the results gathered in the People's Intention Survey conducted by the JICA Study Team, the following are the listed reasons of why the majority of the respondents are not satisfied with the living conditions in the resettlement area:

- The size of the lot is small,
- The house was poorly built,
- The location is very elevated (Banquerohan),
- Water supply and drainage system are inadequate,
- Inadequacy of electricity,
- Lack of street lights,
- Absence of farm lots for farmer resettlers,
- No sources of livelihood,
- Sanitation such as lack of comfort rooms (Banquerohan),

- High transportation cost, and
- Others.

a. Banquerohan Phase I

Of the many problems being encountered by the beneficiaries in Banquerohan Phase I, lack of livelihood opportunities ranked first. The income profile based on the result of the "People's Intention Survey for Resettlers and Candidate Resettlers in Resettlement Site Improvement and Livelihood Development" revealed that the annual income per household is PHP42,075 or a monthly household income of PHP3,506. The income figure derived from this survey is below the PHP4,800 perceived adequate income.

Some resettlers acquired their own farm lots on nearby sites. Some temporarily farm on Phase II lots as of now. Farm sites for resettlers are not yet identified. Other sources of livelihood are abaca weaving, buying/selling. Few go into fishing. Lack of livelihood opportunities in the site have made life difficult for the resettled families and this problem compounded their dissatisfaction to their new homes as shown below.

Perceptions on Resettlement and Resettlement Site

Perception	Total	%
1. Satisfied with the site		
1) Yes	40	35.7
2) No	72	64.3
Subtotal	112	100.0
2. No difficulties in the site		
1) Yes	6	6.2
2) No	90	93.8
Subtotal	96	100.0
3. Good to move to the site		
1) Yes	65	67.7
2) No	31	32.3
Subtotal	96	100.0
4. Beneficiary of livelihood project		
1) Yes	7	6.2
2) No	105	93.8
5. Grand-Total of "Yes" & "No"	416	100.0
"Yes"	*118*	*(28.4)*
"No"	*298*	*(71.6)*

Source: People's Intention Survey conducted by the JICA Study Team in 1999.

b. Banquerohan Phase II

There are no identified problems which are attributed to socio-economic in nature since there are no beneficiaries yet living in Phase II at present. In Phase II site, the following facilities are to be constructed for the entire Banquerohan resettlement site development.

- Community facilities such as multi-purpose center, health and day care center and school,
- Livelihood facilities such as training centers and production areas, and
- Post-harvest facilities for storage of goods.

c. Anislag Resettlement Site

This site is still in the process of absorbing new entrants from the Permanent Danger Zones (PDZs) and the residents would most likely list the following needs:

- Multi-purpose center
- Health & day care center
- Primary school
- Livelihood facilities for cottage industries
- Handicraft and training

2) Basic Facilities

From the list of problems cited by the respondents in the People's Intention Survey, majority of them is attributable to physical development of the resettlement site. As shown in the following table, the improvement of basic infrastructure ranked second (24.5%) most needed project that should be implemented in the site. Of the five major projects needed, job creation or livelihood opportunities still ranked high (26.2%) in the list.

Kinds of Projects Needed to be Implemented

Kinds of Projects Expected	Total	%	Order
1. Job creation	170	26.23	1
2. Improvement of basic infrastructure	159	24.54	2
3. Social services	128	19.75	3
4. Provision of available land	99	15.28	4
5. Upgrading of housing	83	12.81	5
6. Others	9	1.39	6
Total	648 *	100.00	-

Most Beneficial Kind of Livelihood Projects	Total	%	Order
1. Agro-industry and manufacturing	111	38.28	1
2. On-farm production	105	36.21	2
3. Tourism promotion	27	9.31	3
4. Others	24	8.28	4
5. Marine production	23	7.93	5
Total	290 *	100.00	-

Note : * Multiple answers (total number of samples = 180)
Source : People's Intention Survey conducted by JICA Study Team in September - October 1999.

a. Banquerohan Phase I & II

In the aspect of basic facilities, the following are the listed requirements being felt by the resettlers:

- Lack of sufficient water supply
- Installation of toilets for each family
- Access to the coastal areas
- Poor structure of housing units

To develop the Banquerohan resettlement site as a whole integrating the established Phase I area with Phase II planned site, the following are the basic infrastructure and utilities to be constructed in this expansion area.

- Sufficient water supply
- Power supply
- Housing units
- Roads and path walks
- Sanitary units

b. Anislag Resettlement Site

For Anislag resettlement site, the following are required by would-be resettlers :

- Sufficient water supply system
- Reliable power supply
- Improved drainage system

8.5.2 Basic Concept

(1) Purpose of the Project

The Resettlement Sites Development Project in Banquerohan (Legazpi City) and Anislag (Daraga Municipality) aims to improve the existing resettlement sites for the people already settled and/or develop the new resettlement sites for the people still residing in mud & debris and flood danger zones, and likewise for those to be relocated due to implementation of the Yawa River Basin Sabo Project and Legazpi City Urban Drainage Project.

Consequently, the Resettlement Sites Development Project proposed in this Study is designed to cope with the problems the resettlers are actually facing, and satisfy the requirements of the resettlers to some extent to ensure their basic human needs or living environment.

1) Economic Development in the Resettlement Sites

As the major problems in the existing resettlement sites are due to the fact that the sites provide little job opportunity, a wide range of job creation opportunities will be provided to the resettlers considering their adaptability and background. The economic development in the resettlement site mostly concerns the livelihood of the resettlers. The factors to be considered in formulation of livelihood projects and programs are the following:

- Labour-intensive or employment generation program
- Utilization of local resources (materials and expertise)
- Prospects of marketability
- Availability of the utilities (water and energy)

Based on the results of the Area Potential Survey carried out by the JICA Study Team in September – October 1999, the following are the key crops and promising enterprises for livelihood and area economic development:

- Coconut-based Crop Diversification (through inter-cropping)
- Abaca

- High Value Commercial Crops
- Cutflowers and Ornamental Plants
- Non-edible Agricultural Crops
- Maize (Corn)
- Rice (Rice growing)
- Poultry
- Coconut Coir and Coco dust
- Gravel and Sand
- Composting and Recycling Scheme
- Eco-tourism

2) Criteria in Selecting Candidate Resettlers

With a view to upgrading the living environment of resettlers and establishing a growth center for area economic development, the following criteria were adopted in selecting the candidate resettlers.

a. Those who are dwelling in the high risk areas such as:
   - Permanent Danger Zones (PDZ),
   - Slopes of the Mayon Volcano where have been repeatedly struck by the disasters of mud and debris flows, and
   - Flood prone areas.

b. The people living in the right-of-way areas where land acquisition is required for implementation of the structural projects like sabo facility construction and urban drainage projects.

c. The household whose house was totally damaged as a result of the natural disasters including typhoon.
   - The applicant must be owner of the damaged house – not a renter or sharer.

d. Family of low bracket income: its monthly average income must be below the estimated monthly household income of the area[1] (for 5.3 members, PHP10,000 per month as of 1999).

e. The beneficiary occupant who accepts to pay the occupancy and maintenance charge of the site.

[1] The monthly household income in the Study Area is set based on the data used for estimating the target per capita GRDP in formulation of the socioeconomic development scenario.

(2) Basic Conditions for Resettlement Planning

1) Living Condition in Structural Aspect

The living condition of the resettlers in structural aspect must meet at the least the minimum requirements if not of the very ideal characteristics of a dwelling unit, and a physical environment. For the dwelling units, it is advised to have at least the following:

- Adequate space for domestic needs such as bedroom, a kitchen and the like (total floor area of the standard type: 21.7m^2). As to floor plan, refer to Figure 8.5.3.
- Individual bath and toilet
- Sufficient supply for water for drinking and domestic use (150 liters/ capita/day)
- Electric power connection per housing unit
- Garbage disposal and sewage
- Dwelling units must be durable enough to withstand the usual calamities like typhoons or strong winds

Taking into consideration the general situations mentioned above, the basic conditions for resettlement sites development with livelihood programs are as follows:

a. A core house of 21.7m^2 (standard type) will be provided free of charge to the eligible family by the LGU,
b. For expansion and betterment of the core house, financial assistance will be granted to the applicant resettlers (through a multi-purpose cooperative to be established in the site),
c. To those who are going to undertake the gradual expansion of the house in group of more than 5 families, the LGU will extend assistance to supervise its construction works,
d. Maintenance fund of the resettlement site including the public facilities and respective houses should be raised and contributed by the resettlers themselves.
e. To form an integrated community, the resettlement site will include almost all social infrastructures like road, water supply, power supply, drainage & sewerage, elementary school, parks & open space, and even a “productivity center” for livelihood development.

2) Livelihood Support

In addition to improvement of the structural living condition, the livelihood development support needs to be provided by establishing a "productivity center". The resettlement sites development project with livelihood development program is to be formulated and promoted in close coordination with the government agencies (both national and local) and organizations concerned including supporting institutions (international donors, private sector and NGOs).

The basic conditions for supporting the livelihood development of the resettlers include the following:

a. Institutional and legal arrangements among the implementing agencies and organizations concerned,
b. Social preparation including briefing to the property owners and affected households, and public hearings,
c. Establishment of community relations through community development workers,
d. Setting-up of community organizations, especially multi-purpose cooperative and cooperative business association (CBA),
e. Provision of micro-lending scheme to support the resettlers to open up the livelihood enterprises, and
f. Training for livelihood development and vocational guidance
g. Organizational set-up of a "Resettlement Committee" to coordinate/ ensure the resettlement activities.

(3) Expected Number of Resettlers and Households by Job Category

The following table shows the expected numbers of resettlers, estimated numbers of economically active persons and to be engaged in the livelihood projects in the resettlement sites.

Expected Number of Resettlers and Households by Job Category

Item	Banquerohan		Anislag
	Phase I	Phase II	
1. No. of Total Households	600	460	635
(Total)	1,060		
2. Estimated No. of Economically Active Persons (2.47 per HH)*	2,618		1,568
3. No. of Persons to be Engaged in Proposed Livelihood Projects (1.5 persons per HH)	1,590		953
(1) Abaca Handicrafts (20%)	318		191
(2) Pilinut Processing (15%)	239		143
(3) Coco Coir Production (20%)	318		191
(4) Hollow Block Making (5%)	80		48
Sub-total	955		572
% to be Engaged by the Proposed Livelihood Projects	60%		60%
4. Others (40%)**	635		381

Notes: * 2.47 persons are economically active according to the results of the People's Intention Survey.

** Others include the jobs to be generated by the above livelihood projects like trade & commerce, transportation, public services, etc.

The livelihood projects proposed in the respective resettlement sites are designed to assure the average monthly income of PHP7,000 per household. The equation for calculation of this monthly average income is as follows:

- Daily wage per worker (PHP180) x Monthly working days (26 days) x No. of persons to be engaged in proposed livelihood projects per household (1.5 persons) = Monthly average income per household (PHP7,020)

Figure 8.5.4 indicates the proposed structure for implementing the resettlement sites development with livelihood programs and promoting the socio-economy of the Study Area.

To improve and strengthen the capabilities of the existing communities at both Banquerohan and Anislag, it is recommended to start an "institutional supporting program" through establishing a viable "Multi-purpose Cooperative" in each resettlement site. This might be a must and starting point to lead the projects and programs to be a success.

8.5.3 Layout Design

(1) Banquerohan Resettlement Site (Phase I & II)

1) Land Use Layout Plan (Area Development Plan)

a. Settlement Area

(Banquerohan Phase I)

Residential lots to be generated in a particular site should have a maximum of 70% of the total project area. This area comprises the buildable area (residential and commercial lots). The remaining 30% is allocated to open spaces (circulation, parks and community facilities). For Banquerohan Resettlement Site (Phase I & II), the following are the site area and the standard home lot size:

Home Lot Size Profile

Name of Resettlement Site	Area (ha)	Standard Home Lot Size (m^2)
1. Banquerohan Phase I	18.93	90 - 298
2. Banquerohan Phase II	27.07	120 - 210

For Banquerohan Phases I and II, the lot sizes are variable in some parts due to topography of the place. The following table shows the land use distribution for the development of Banquerohan Phase I.

Land Use Distribution of Banquerohan Phase I

Land Use	Area (ha)	%
A. Buildable Area		
1. Residential Lots	7.89	41.68
2. Commercial Lots	0.65	3.43
Sub-total	8.54	45.11
B. Public and Common Area		
1. Reserve Lots	5.53	29.21
2. Park	0.65	3.43
3. Foot Path	1.31	6.92
4. Road Lot	1.21	6.39
5. C.D.S.(cul-de-sac)	0.13	0.69
6. Unbuildable	0.48	2.54
7. Waterway	0.07	0.37
8. Creek Lot	1.01	5.34
Sub-total	10.39	54.89
Grand Total	18.93	100.00

Source : NHA-Region V Development Plan for Banquerohan Phase I

(Banquerohan Phase II)

27.07ha of resettlement site is still undeveloped, although NHA-Region V Office already introduced the preliminary land development such as subdivision survey, construction of reinforced concrete box culverts, macadam main roads, sanitary units and CHB-lined open canals. The number of generated lots for residential and commercial purposes are 449 and 11, respectively.

The area allotted for future residential development (reserve residential) can be used as production area. The parameter in computing the size of the production area was adopted from the existing resettlement sites of the NHA. On the average, about $60m^2$/household is used as factor in deriving the allocation for production area. The required land size for the production area is computed below:

Production Area = Expected number of households x $60m^2$/household
= (600 [Phase I] + 460 [Phase II]) x $60m^2$
= $63,600m^2$ (6.36ha) for the whole Banquerohan area

Based on this, the land use allocations for Banquerohan Phase II are proposed as summarized below:

Land Use Allocation for Banquerohan Phase II

Land Use	Area (ha)	%
A. Buildable Area		
1. Residential Lots	5.23	19.32
2. Commercial Lots	0.18	0.67
3. Residential (Reserve)	2.39	8.83
Subtotal	7.80	28.82
B. Public and Common Area		
1. Open Space	1.75	6.46
2. Circulation	2.33	8.61
3. Farm Lots	8.83	32.62
4. Production Area	6.36	23.49
Subtotal	19.27	71.18
Grand Total	27.07	100.00

Source : NHA-Region V Development Plan for Banquerohan Phase II

b. Agricultural Land

(Banquerohan Phase I)

As shown in the previous table: Land Use Distribution of Banquerohan Phase I, the area does not have farm lots that can be used for agricultural purposes. Since the lot sizes ranges from 90 to 298m^2, these lot sizes do not seem to be able to sustain a commercial level of backyard farming that can answer the daily needs of the beneficiaries.

(Banquerohan Phase II)

The area allotted for agricultural lots is 8.8ha or about 32.51% of the total area of Phase II, and about 19.13 %(8.8ha/46ha) of the total area for Phases I and II. It is not sufficient to accommodate the farm size requirements of all the farmer resettlers which may be given at 1.0ha per farming beneficiary.

The results of the People's Intention Survey conducted by the JICA Study Team (regarding the kinds of projects needed to be implemented) revealed that the provision of available farmland (15.3%) ranked fourth among the most expected projects being awaited by the beneficiaries. The on-farm production ranked second most beneficial kind of livelihood projects being perceived by the resettlers and candidate resettlers. For this reason, provision of farm lots to the farmer-resettlers adjacent to the resettlement site needs to be considered.

c. Industrial Zone

(Banquerohan Phase I)

The development done by the NHA-Region V designated this site into purely residential-commercial-institutional area. The whole area has already been constructed with core housing units. The open spaces indicated in the development plans are located in steep slopes.

It would be noted that construction on very steep slopes would either be costly or may pose danger on lives and properties in the near future. Hence, those areas would have to be planted with trees and shrubs to prevent soil erosion. It is recommended that existing development plans be followed and if community facilities are ever to be constructed, they should be located at the designated public area which still has enough space.

(Banquerohan Phase II)

Banquerohan Phase II has an area for commercial lots located along the national road as well as a reserve area for residential use and area for farm lots. Based on this situation, it would be economically viable to put a single production area in Phase II which will serve the whole of Banquerohan Resettlement Site (Phase I & II). This production area will accommodate the productivity center, business center, showroom, skills training center, and other vital livelihood facilities.

d. Public and Common Area

(Banquerohan Phase I)

The topography of Phase I dictates that much of the area would have to be open space. Steep slopes created mini-parks wherein residents use it for backyard farming or just plain vegetation area. Moreover, a considerable area of about 4,806m^2 which is classified as unbuildable can be considered as open space.

Much of the steep terrain is already protected by boulder rip-rap. The total area for parks and open space including unbuildable area is about 10.39 ha or 54.89% (10.39 ha/18.93 ha).

(Banquerohan Phase II)

Open spaces and pocket parks are provided in this site. Open spaces are provided in the easement of waterways that runs through the site. Steep slopes created bigger open spaces. By classifying farm lots and reserved residential areas into open spaces, the total open spaces would have a total area of 21.7 ha or about 80.0%. Provision of open space is more than enough which gives the site bigger circulation and production areas for beneficiaries.

2) Infrastructures

a. Road and Transportation Network

(Banquerohan Phase I)

The designs of roads and footpaths for the site conform to the low-cost development guidelines of the NHA. The main roads intersect the national road on two points. All lots have access either through the main roads or the footpaths.

All the main roads and the footpaths were graded and compared with NHA standards. The total area of circulation network for Phase I is 2.5 ha or 13.3% of the total area.

Types of Roads for Banquerohan Phase I & Phase II Resettlement Site

Sites	Type of Road	Right-of-Way (m)	Pavement	Carriag way	Length (m)
Banquerohan Phase I	Major/main	10.0	Macadam	6	478
	Minor/secondary	8.0	Macadam	6	915
	Pathwalk/Alley	3.0	Compacted sub-grade	3	4,367
Banquerohan Phase II	Major/main	10.0	Macadam	6	960
	Minor/secondary	8.0	Macadam	6	200
	Service/tertiary	6.5	Macadam	5	663
	Pathwall/alley	3.0	Compacted sub-grade	3	2,597

(Banquerohan Phase II)

For Phase II, the circulation network is circumferential in design and has two connecting points at the national road. The design finish and the specifications are identical to the road and pathwalk designs of Phase I. The total area of roads and pathwalks is 2.3 ha or about 8.6% of the total area of the Phase II site.

b. Water Supply System

The water supply being used in Banquerohan Phase I is shallow well. Of the 24 shallow wells constructed in Phase I, only about 8 are in operation and the remaining are either destroyed or no longer capable of drawing ground water. The residents get their water from spring which is continuously flowing in Phase II. The problem of water supply worsens during the dry season.

Since water supply is very unstable especially during the dry season, it is recommended that the drilling of deep well be done for two sites. The minimum depth of well is 150.0m from the ground or until the aquifer in the locality is reached. The following table shows the water requirements of the two sites and the recommended capacity of the tanks and the distribution mains.

Water Demand for Banquerohan Resettlement Site

Item	Banquerohan Phase I	Banquerohan Phase II
1. No. of Housing Units	600	460
2. No. of HH/Unit	5	5
3. Average Daily Demand	150 liter/capita/day	150 liter/capita/day
4. Peak Factor	1.5	1.5
5. Design Population (5 years)	Population = 1.5 x 600 x 5 =4,500	Population = 1.5 x 460 x 5 =3,450
6. Average Daily Demand	4,500 persons x 150 liters = 675,000 liters	3,450 persons x 150 liters = 517,500 liters

Note: For more detailed information, refer to the Supporting Report (2), Chapter XXII.

Maintenance and operating costs will be covered by monthly dues to be collected by the community association. The water rate will be determined by the association in consultation with the Legazpi City Water District. The water distribution system layouts for the two sites are given in Figures XXII 3.4 and XXII 3.5 (Supporting Report (2)).

c. Electric Power Supply System

The power supply system for Banquerohan Phase I is already complete and is now operational. All the area is now being serviced by ALECO. The housing units being constructed now have yet to be interconnected to the power main grids. For Banquerohan Phase II, power supply has not yet been installed by ALECO. The power supply system layout for Banquerohan is shown in Figure XXII 3.6 (Supporting Report (2)).

The detailed design and analysis of the power reticulation system as well as the installation or upgrading of power supply will be carried out by the local electric cooperative. In conformity with the design standards or provisions of the Electrical Code of the Philippines, the street lighting, utility poles and wiring system will be installed.

d. Public Building

Elementary School Building

The provision of elementary school facilities for Banquerohan is a must to arrest the rising incidence of illiteracy and attract future resettlers in this site. From the data furnished by DECS-Region V, Banquerohan elementary school has the following student profile and facilities:

Profile and Facilities of Banquerohan Elementary School

Level	No. of Students	No. of Classrooms
- Primary (I – IV)	704	17
- Intermediate (V – VI)	325	8
TOTAL	1,029	25

Source: DECS – Region V

This student population comes from the total barangay population of 5,412 persons according to latest DSWD-Legazpi City statistics. A 25-classroom school will have to be constructed in Banquerohan Phase I site.

Chapel

The chapel design and its size is likely the same with the one constructed and already being used in Banquerohan Phase I. The layout and the dimensions are shown in XXII 3.10 (Supporting Report (2)). The floor area requirement for this chapel is 233m^2 (10m x 23.3m). The proposed lot area requirement for this facility is about 1,500m^2 (30m x 50m).

Since there is already an existing chapel in Phase I, it is worth to consider the expansion of this chapel so that it can adequately serve the residents of both Phase I & II of Banquerohan resettlement site.

Public Hall/Multi-Purpose Hall

This building is planned to serve as venue for the beneficiaries and the local government personnel to conduct outreach seminars, training, and other important meetings. This could also serve as barangay outpost during night time. The planned size of the multi-purpose hall is about 55.0m^2. This floor area is the regular size of public hall being constructed by NHA in some of its developed resettlement sites.

This multi-purpose hall is proposed to be built in Banquerohan Phase II and Anislag resettlement sites. The typical building layout and its dimensions are shown in Figure XXII 3.11 (Supporting Report (2)).

Others

Health and Day Care Center

This community facility is proposed to be built in Anislag resettlement site. This facility is planned with an area of 60m^2. The size adopted conforms to the existing floor area of barangay health facilities already constructed by

NHA in its resettlement/relocation sites. It is provided with an office, kitchen, and single toilet.

This center is dual in use. One half can be a day care center while the other half can be the clinic/check-up area to be used by visiting doctor or health worker. The health center can be installed with three hospital beds in case of emergency. The typical building layout for this type of building is shown in Figure XXII 3.12 (Supporting Report (2)).

Productivity Center

The productivity center is envisioned to be the venue for livelihood and skills training for the beneficiaries. The conduct of training is in line with the local government thrust of providing livelihood opportunities to majority of the people living in the resettlement sites. The building is provided with ample floor area for training, big kitchen area for demonstration, office for livelihood officers and two big toilets. This building measures about 90m^2.

For the training area, large working tables (quantity: 6) and monobloc plastic chairs will be provided for the trainees. Big display cabinets will also be provided to showcase the quality and variety of goods being produced in the site. Audio-visual equipment is to be installed for skills training, demonstration and technology transfer. Floor layout and elevations are shown in XXII 3.13 (Supporting Report (2)).

Multi-purpose Warehouse

This warehouse will be used by recognized resettlers' cooperative or community association. This building is a component of the livelihood support package for the beneficiaries. This will enable the users to place the goods safely especially during wet season and in the event of typhoons. The building is an all-weather structure and capable of withstanding super typhoons. It has three big compartments so that a variety of goods can be stored at the same time. The area of the warehouse is about 325m^2 including the office of the caretaker. The required area proposed (300m^2) will be good enough to meet the emergency storage needs of resettlers. The floor layout and elevations are shown in Figure XXII 3.14 (Supporting Report (2)).

3) Housing Lot Plan

The design standards for "new resettlement scheme" proposed by the JICA Study Team are the following.

a. Standard Criteria

Considering the respective family conditions, especially the number of household members and their economic situation, the following lot allocation and house size are schemed:

Typical Lot Allocation

The standard lot size is 120m^2 (10m x 12m). The total lot area occupies 70% of the total resettlement site and the remaining area (30% of the gross area) will be reserved/used for communal facilities like main and access roads, town hall, plaza, school building, health center and others (referring to the standard of NHA)

House Size (or Floor Area)

The standard house (floor) area proposed in this JICA Study is 21.7m^2 = (4.8m x 4.2m) + (1.4m x 1.1m). Financial assistance for construction of a core house of 21.7m^2 will be granted to beneficiaries resettlers. The core house will consist of two bedrooms, living room, kitchen, toilet and bath (refer to Figure 8.5.3).

b. House Building

The house (core shelter) should be structurally strong to withstand 200 km/h wind velocity, earthquake of moderate intensity (6 Richter Scale) and other similar natural hazards.

Regarding the expansion and betterment of the respective house accommodations, modular upgrading scheme allows for the gradual improvement in the structure according to the needs, preferences, and capacity of the families.

(2) Anislag Resettlement Site

1) Land Use Layout (Area Development Plan)

a. Settlement Area

The resettlement site with 21.35ha in Anislag is the second resettlement site in Daraga Municipality, Albay Province. The standard lot size is 120m^2.

The total number of generated lots for the resettlement portion is 635. There are now 120 completed and unfinished core housing units being constructed

in the resettlement site. The subdivision layout for Anislag resettlement site is shown in Figure XXII 3.15 (Supporting Report (2)).

The estimated area to be allocated for production area is given below.

Estimated Lot Size for Production Area =
Estimated No. of Households (635) x 60m^2 = 38,100m^2

With the re-allocation of certain portions of the area for socialized housing, the resulting revised land use is shown below:

Land Use Allocation for Anislag Resettlement Site

Land Use	Area (ha)	%
A. Buildable (Phase I)		
1. Residential	*8.15*	*38.17*
B. Public and Common Area		
1. Park	*1.41*	*6.60*
2. Circulation	*2.21*	*10.35*
3. Earth Canal	*0.23*	*1.08*
4. Easement	*0.26*	*1.22*
5. Community Facilities	*0.31*	*1.45*
Subtotal (Phase I: A. + B.)	12.57	58.87
C. Reserve (Phase II)	4.97	23.28
D. Production Area	3.81	17.85
Grand Total	21.35	100.00

Source: NHA-Region V Development Plan for Anislag Resettlement Site

b. Agricultural Land

For this resettlement site, although it is developed in terms of physical components, it will be noted that it lacks farm areas that will sustain agricultural production. The adjacent area although planted to coconut trees are privately owned.

The Farm Land Trust Management scheme hopes to provide farm lots where farmer-resettlers can cultivate cash crops. The approximate farm lot requirement for all the farmer beneficiaries is about 168 ha. This figure is arrived at by multiplying the number of beneficiaries (635 as planned) by 26.9% (assumed percentage of households which is into farming as reckoned from the People's Intention Survey) and by 1 ha per beneficiary.

c. Industrial Zone

The industrial zones is not in the development plan of Anislag Resettlement Site either. An open space designated as area for community facilities is located in Block 46. Areas to be used for livelihood purposes such as production areas and productivity center would most likely be situated in the still undeveloped socialized housing site or from the acquisition of adjacent private lands by the Local Government.

d. Public and Common Area

The site is not provided with ample open space and parks as compared with the two other sites (Banquerohan Phases I and II). The site is maximized in terms of lot generation for residential use. It allocated a space for community facilities at Block 46. The total area for open space is 4.42 ha or 35.16% (4.42 ha/12.57 ha) of the total project area. This is still within the prescribed development standards of the NHA. However, this is still small when the need for socio-economic components are considered.

2) Infrastructures

a. Road and Transportation Network

This resettlement site also followed the minimum circulation design requirements. The macadam main road is now serviceable. The total area of road lots and footpaths is 2.2 ha or equivalent to 17.50% (2.2 ha/12.57 ha) of the total project area (refer to the above table).

The types of roads to be constructed for Anislag resettlement site are shown below.

Types of Roads of Anislag Resettlement Site

Sites	Type of Road	Right-of-Way (m)	Pavement	Carriage way	Length (m)
Anislag Resettlement	Major/main	10.0	Macadam	6	333
	Minor/secondary	8.0	Macadam	6	338
	Service/tertiary	6.5	Macadam	5	718
	Pathwall/alley	3.0	Compacted sub-grade	3	3,800

b. Water Supply System

The existing water supply being used in the area is provided by shallow wells with pitcher type pump. The 28 shallow wells at the site have good water quality and some of them are being used by the first batch of resettlers.

However, 24 hand pumps have to be temporarily removed to avoid rampant theft of jetmatic pumps. Below is the table for the computed water demand for Anislag Resettlement Site.

Water Demand for Anislag Resettlement Site

Item	Anislag Resettlement
1. No. of Housing Units	635
2. No. of HH/Unit	5
3. Average Daily Demand	150 liter/capita/day
4. Peak Factor	1.5
5. Design Population (5 years)	Population = 1.5 x 635 x 5 =4,763
6. Average Daily Demand	4,688 persons x150 liters = 703,200 liters

Note: For more detailed information, refer to the Supporting Report (2), Chapter XXII.

c. Electric Power Supply System

The site as of the moment does not have power lines that will supply electricity. The nearest power main grid is along the main provincial highway which is about 1.50km away. However, inquiry from ALECO (Albay Electric Cooperative) revealed that the power supply will be made available in 2000 and design and layouts have been finalized.

d. Public Building

Elementary School Building

The provision of elementary school facilities both for Anislag is a must to attract future resettlers. The elementary school, which is the lone barangay school, is 1.5km away from the resettlement site. The estimated future residents of 635 will exceed a thousand beneficiaries when the second phase of the site is developed and will be completely filled up. Thus, the requirement for elementary school facilities is almost the same to the one being proposed for the Banquerohan Phase I and II. Adopting this design of the school building is justifiable since residents from the adjacent area would get to avail of public education which is adjacent to their present houses.

Chapel

The chapel design and its size is likely the same with the one constructed and already being used in Banquerohan Phase I. The layout and the dimensions are shown in Figure XXII 3.10 (Supporting Report (2)). The floor area requirement for this chapel is 233m^2 (10m x 23.3m). The proposed lot area requirement for this facility is about 1,500m^2 (30m x 50m). As to the dimensions, they are based on the existing chapel in Banquerohan Phase I.

Public Hall/Multi-purpose Hall

This building planned to serve as venue for the beneficiaries and the local government personnel to conduct outreach seminars, training and other important meetings. This could also serve as barangay outpost during night time. The planned size of the multi-purpose hall is about 55.0m^2. This floor area is the regular size of public hall being constructed by NHA in some of its developed resettlement sites. Barangay halls in rural areas have the same size as recommended.

Others

Health and Day Care Center

This community facility is be built in Anislag resettlement site. Its facility is planned with an area of 60m^2. The size adopted conforms to the existing floor area of barangay health facilities already constructed by NHA in its resettlement/relocation sites.

This center is dual in use. One half can be a day care center while the other half can be the clinic/check-up area to be used by visiting doctor or health worker. The health center can be installed with three hospital beds in case of emergency.

Productivity Center

The productivity center is envisioned to be the venue for livelihood and skills training for the beneficiaries. The conduct of training is in line with the local government thrust of providing livelihood opportunities to majority of the people living in the resettlement sites. The building is provided with ample floor area for training, big kitchen area for demonstration, office for livelihood officers, and two large washrooms. This building measures about 90m^2.
The productivity center is proposed to be constructed on the open area which is part of the Phase II of Anislag.

Multi-purpose Warehouse

As discussed in the proposed warehouse to be used for the Banquerohan resettlement sites, this design can be adopted to enable farmers have a durable storage space especially during strong typhoons. This warehouse will be used by recognized resettlers' cooperative or community association.

Storage fees will be paid to the cooperative/association, the rate of which will be determined by all members.

3) Housing Lot Plan

The design standards proposed by the JICA Study Team for Banquerohan Resettlement Site development will be also applied to Anislag Resettement Site development. For detailed information, refer to the previous Section 8.5.3 (1)-3). As to the standard housing layout plan, refer to Figure 8.5.3.

8.5.4 Preliminary Structural Design

(1) Banquerohan Resettlement Site (Phase I & II)

1) Infrastructures

a. Road and Transportation Network

The existing roads and alleys for the resettlement sites are all made up of compacted subgrade with no all-weather pavement on it. The macadam roads are the most easily adopted type of road being implemented in any relocation site of the government. Though it wears easily, repair can be easily done by the barangay since the materials are available within the site.

For the pathwalks and alleys, concrete paving blocks can be easily manufactured by the barangay. The ideal size of the paving block is about 0.3m x 0.3m x 0.05m thick. This paving block can then be laid on compacted subgrade of the pathwalks.

b. Water Supply System

The layout plans for the water supply for Banquerohan Phases I and II are presented in Figures XXII 3.4 and XXII 3.5 (Supporting Report (2)). The deep wells to be drilled in the site will be used as water source for the elevated water tanks. Centrifugal pumps will be used for drawing underground water and raise it to the elevated tanks.

Stored water in the tanks will then be distributed using plastic pipes. Communal faucets will then be installed from which the residents can get their supply of potable water. At least 10 residents will be using one communal faucet for their domestic water needs.

c. Electric Power Supply System

The layout plans for the electrical power supply is presented in Figure XXII 3.6 (Supporting Report (2)). The layout shows the transformer requirement as well as the pole and wires to be used. The electric power layout plans was made to ascertain the cost of energizing the Banquerohan Phase II site.

d. Sanitary System

The existing sanitary layout for Banquerohan Phase I and II needs upgrading and rehabilitation, respectively. The toilets constructed in Phase I were proposed to serve four residents per toilet. The toilets were therefore communal in use. The problem with this kind of set up is the quick deterioration of the facility and the manner of the usage among the beneficiaries. For Phase II, the constructed septic tanks were already destroyed beyond repair. Complete rehabilitation will have to be done for the sanitary system to be functional and become useful for future resettlers.

e. Access Roads

Residents of Banquerohan Phase I have no direct access to the coastal areas. The existing path is about 1.5 kilometer long. So, the bringing of goods to and from the coastal area is rather difficult and does not encourage residents to venture in aquaculture development. It is therefore suggested to provide wider access roads connecting the resettlement site to the coastal area. This will open up new avenue for the residents contemplating of going into fishing business or any related endeavors.

2) Housing Lot

The recommended lot size to be able for a family to have ample space for improvement is about 100m^2 (10m x 10m) lot configuration

3) House Building

The core house with an area of 21.7m^2 provisions for expansion. Additional bedrooms provided for the bigger models consist of 12m^2 room (4m x 3m). The core house will consist of two bedrooms, living room, kitchen, toilet and bath.

Regarding the expansion and betterment of the respective house accommodations, modular upgrading scheme allows for the gradual improvement in the structure according to the needs, preferences, and capacity of the families.

4) Work Volume

The detailed data on work volumes for Banquerohan Resettlement Site development are given in Section XXIV 3.5 (Supporting Report (2)).

(2) Anislag Resettlement Site

1) Infrastructures

a. Road and Transportation Network

In order to provide easy and smooth access from the main provincial road to the resettlement site, it is recommended that the barangay access road, which leads to the site, be paved with all-weather asphaltic-based paving materials. This will help neighboring barangays as well and delivery of goods to and from the site more conveniently. Living conditions of the residents in the site as well as the adjacent communities will be benefited.

For the pathwalks and alleys, concrete paving blocks can be easily manufactured by the barangay. The ideal size of the paving block is about 0.3m x 0.3m x 0.05m thick. This paving block can then be laid on compacted subgrade of the pathwalks.

b. Water Supply System

The layout plans for the water supply for Anislag resettlement site is presented in Figure XXII 3.16 (Supporting Report (2)). The deep wells to be drilled in the site will be used as water source for the elevated water tanks. Centrifugal pumps will be used for drawing underground water and raise it to the elevated tanks.

Stored water in the tanks will then be distributed using plastic pipes. Communal faucets will then be installed from which the residents can get their supply of potable water. At least 10 residents will be using one communal faucet for their domestic water needs.

c. Electric Power Supply System

The layout plans for electrical power supply system will be provided by ALECO. The costing and the materials requirements for the project is already prepared and just awaiting the actual implementation by the concerned agency.

d. Sanitary System

The sanitary system for Anislag resettlement site is already complete and is now being used by the residents themselves. Each unit has its own toilet unlike in Banquerohan Phase I where about 4 residents share the use of 1 toilet. The development of sanitary system for Anislag is a septic tank type wherein the residents will just provide a toilet bowl and construct their own toilet. With this mode of construction, residents will provide closer maintenance of their respective units.

2) Housing Lot

As recommended for Banquerohan Phase I and II, the lot size of 100m^2 is the lot area which was adopted in the lot distribution for Anislag site.

3) House Building

The core house has an area of 21.7m^2 with a provision for expansion. Financial assistance for construction of this core house will be granted to beneficiaries resettlers. The core house will consist of two bedrooms, living room, kitchen, toilet and bath. As to the expansion and betterment of the respective house accommodations, modular upgrading scheme allows for the gradual improvement in the structure according to the needs, preferences, and capacity of the families.

4) Work Volume

The detailed data on work volumes for Anislag Resettlement Site development are given in Section XXIV 3.5 (Supporting Report (2)).