c. Cacutud

Cacutud community is an old settlement that dates back to the Spanish period as indicated by the old chapel built in the style of the Spanish period. Most of the people in Cacutud engaged agriculture and sugar cane was the most profitable crop. Standard of living was relatively high. With the river enriching their lands for sugar cane growing, the community has always been enjoying bumper crops.

2) Tarlac

a. Bamban

The people of Bamban viewed their town as progressive and fast growing, as sugarcane brought prosperity to the town. Rich in historical development, as marked by the abandoned Central Azucarera de Bamban. There are famous families of Lagman, Campo, Sibal, Macale, Dayrit, Lugtu, Vergara, Dela Cruz and other prominent families that have brought Bamban one of the richest town in Tarlac. Apart from the vast sugarcane lands, the residents consider Bamban River a rich source of aquatic life. Education and commercial activities were what their community perceived as important.

b. Concepcion

Prior to Mt. Pinatubo's eruption, Concepcion was a typical rural town in the irrigated rice producing area. For almost four decades, rice has been the primary crop in Concepcion. Due to the construction of the Parua River Control Dike in the second half of the 1970s, the accessibility of deep wells in the 1980s and the wider service area of communal irrigation system, rice production of the Concepcion farmers was bolstered. The farmers were harvesting two to three times a year, giving them a substantial income. People in San Vicente claimed that they did not use fertilizers because the soil was naturally fertile.

Many of the farmers had diversified sources of income. Duck keeping and vegetable growing were popular means of increasing cash income. The significance of rice production in Concepcion's economy is matched by the thriving enterprises based on agriculture. Half of the industries in the municipality and nine of its commercial enterprises supported by rice farmers.

P.2 POST-ERUPTION ENVIRONMENTAL CONDITIONS

2.1 PHYSICO-CHEMICAL ENVIRONMENT

(1) Changes on River System

As a result of Mt. Pinatubo eruption, existing water regime of Sacobia/Bamban and Abacan Rivers basins have been drastically changed over very short period of time. Comparing to the changes of the watershed areas generally very slow over long period of time, the changes of the water regime in the Sacobia/Bamban and Abacan River basins are of their extremity.

Those of small streams running parallel on both sides of Bamban River in the area adjacent to Rio Chico River have been blocked by lahar materials and the courses of drainage have been changed drastically. Thus, the use of these streams as sources of water for agriculture and domestic water should change over time.

Depending on the way the water flow, there are a lot of flood damages in the area where it was not the case before.

(2) Water Quality

1) Description of the Sampling Site

a. Sapang Libutad

The water in Sapang Libutad has been degraded by some amount of the growth of grass on both sides of the river. The sampling point was beside a garbage dump, and therefore, some amount of organic matter from the dump to the river is obvious. The water at the time of sampling was slightly turbid as a result of sediment mobilization caused by the moderate velocity of the stream flow of 0.3 m/sec. The value of pH was at 7.0. The dissolved oxygen (DO) was in the average of 6.167 ppm.

b. Dolores

The place is in Mabalacat, Pampanga. This part of the Sacobia River system is heavily disturbed by dredging operation and heavy construction vehicle. Water depth was less than 6 inches at the point where the dissolved oxygen was determined and water samples taken. At the time of sampling, the velocity of the river flow was around 0.3 m/sec. The value of pH was at 7.5 and the dissolved oxygen was averaged at 7.33 ppm.

c. Sapang Bato River

Quarry operation was in progress at the time of sampling. The river was practically dried up because of low flow. Water sample was taken from what remains as shallow stream of water. The depth was approximately 3 inches. The river bed was from sandy to rocky with high amounts of silt deposition. The value of pH was measured at 7.8 and the dissolved oxygen was averaged at 6.1 ppm.

d. Clark Air Base

The source of water sample was a faucet supplied directly by the river. The location was at the checkpoint in the north of the Clark Air Force Base. The value of pH was measured at 6.5.

e. Cacutud

The place is in Mabalacat, Pampanga. Only the ground water sample was taken from this sampling point. The source was an artesian. The pH was measured at 6.5.

f. San Pablo

The place is Mexico River in Mexico, Pampanga. The water was flowing fast at 1 m/sec. Turbidity was rather high; whitish brown and it appears to be with high content of suspended solid. Depth of the water at the point of sampling was less than 1.5 meters. The value of pH was 5.5 and the nearby swampy area showed a pH of 6.5. The river water is more acidic than stagnant waters along the bank. The dissolved oxygen averaged at 6.05 ppm.

g. Bamban

The flow rate of the sampling site was 1 m/sec. The water was whitish brown and highly turbid with pH value of 7.8 and an average DO of 7.8 ppm.

h. Rio Chico River (Culatingan, Concepcion, Tarlac)

The place is in Barangay Culatingan of Concepcion in Tarlac. The portion of Rio Chico River was very well covered by Saccharum officianarum. The water in the river was almost stagnant and its depth was half a meter. The water was relatively oxygen-depleted with an average of DO content of 4.23 ppm and 2.2 ppm at two sampling points. The pH value was slightly acidic at 6.8.

i. San Francisco Bridge

The sampling area near the dike was relatively shallow, less than half-a-meter deep. River flow was around 1 m/sec. The water was whitish brown. The DO content was normal at 6.1 ppm and the pH value was 7.5.

j. Sapang Bitas

The sampling point was a segment of river in the middle of dike construction area. The water was less than half-a-meter deep with a velocity of around 1 m/sec. The water was relatively less silted than the other rivers, possibly because of the different nature of the river bed material. The water was relatively well-aerated as DO value was recorded at 6.142 ppm and the pH value was 6.5.

2) Total Dissolved Solids (TDS)

Tables P.2.1 and P.2.2 shows that, between 1991 and 1994, the TDS in Rio Chico River remained below 190 mg/l. In Sacobia River, a definitely increasing trend of TDS was noted between 1991 and 1994, the amounts in recent determinations being doubled compared to that recorded earlier. Abacan River, however, did not indicate any changes in TDS value.

Results of the present study pertaining to surface water in some areas in Angeles City, Mabalacat , Mexico, and Magalang, all in Pampanga; and Bamban and Concepcion in Tarlac show that considerable increase in TDS concentration has taken place (Table P.2.2). The minimum value of TDS established in the study is roughly the same as to the maximum of Sacobia River in 1991-92 while the maximum is a little less than two and a half time as large as that of the TDS value of the river in 1991-1992. No pre-eruption record on TDS was available.

With respect to groundwater, Table P.2.3 shows the groundwater sampled in the places in Pampanga and Tarlac. They had TDS levels ranging from 322 mg/l to 429 mg/l in 1991. Comparing to them with the result of the study, it can be concluded that the present minimum values are slightly higher than the mean maximum value of the earlier record. Furthermore, the present maximum is slightly higher than twice the earlier recorded maximum value. Although rising TDS values are indicated, these are still below the standard.

3) pH

The value of pH of 5.5 in the lakes in and around Mt. Pinatubo has been observed in relation to seismic events and volcanism.

The DPWH data on the Rio Chico River indicate that the river developed a minimal decrease in pH value between 1991 to 1993. The value was 0.6 (Table P.2.1). Most of the present determinations indicate that surface waters tend to be on the slightly alkaline side (Table P.2.2). Three places out of the eight sampled showed a slight development of acidity. Sapang Bato River was found to have changed remarkably from its moderately acidic pH of 6.3 in 1982 to a present slightly alkaline pH of 7.8. All of the result of study is within the normal range. Unpublished information obtained by Zafaralla and Associates in Cauayan River, which presently empties into Sacobia Lake ranged from 6.5 to 9.6. The Sto. Tomas River shows pH values in the range of 6.5 to 7.5.

In the case of ground water, the 1991 pH levels in various sampling points in Pampanga and Tarlac varied within the normal range (Table P.2.3).

4) Dissolved Oxygen (DO)

Zafaralla and Associates is the only organization engaged in an on-going examination of the behavior of this parameter in various bodies of water in Tarlac and Zambales. They reported that there was a generally normal level of DO in the Cauayan River and Sacobia Lake after the eruption. The mean range of DO is from 5.8 - 9.6 ppm.

5) Chlorides

Data on the Sacobia and Abacan Rivers gathered by the DPWH indicate a seeming inconsistent trend in the levels of this parameter from 1991 to 1994 (Table P.2.2). Unpublished data of Zafaralla and Associates indicate a chloride mean range of 185 to 258 ppm for the Cauayan River-Sacobia Lake system. The present levels observed in the surface and groundwater compared favorably (Tables P.1.5, P.2.1, P.2.2, P.2.3 and P.2.4).

6) Calcium

Information gathered by the DPWH on surface water between 1986 to 1994 in Rio Chico River indicate a definite increase of over 70 percent of calcium content in the water (Tables P.1.15, P.2.1 and P.2.2). Sacobia River similarly manifested an increasing trend. However, the Abacan River did not. The present minimum of 60 mg/l is lower than the minimum observed by the DPWH but much higher than the levels noted in 1982 by the GIRD. The present maximum of 234 mg/l is lower than the maximum established by the DPWH for Sacobia River.

The value of calcium in the groundwater examined in 1991 had a mean range of 17 to 22 mg/l (Table P.2.3). The increase ranges from four to almost six times of the maximum value of 22 mg/l (Table P.2.3).

7) Magnesium

The IGST findings presented in Table P.2.3 that indicate the mean magnesium range in 1991. The value is from 8 mg/l to 17 mg/l. The present data (Table P.2.2) indicate that present levels may range from a low of approximately 3 mg/l to a high of 132 mg/l, the indicative of an increase of magnesium levels in surface water.

The value of Magnesium content in the present groundwater ranges from non-detectable to 47 mg/l (Table P.2.4). The value is more closely related to the surface water value reported by the GIRD in 1982.

8) Hardness

There is an increasing trend in the hardness of the water in Sacobia River examined from 1991 to 1994 (Table P.2.1 and P.2.2). The highest value was 923 mg/l. Abacan River, however, did not show any changes in hardness.

The Sapang Bato River datum of 325 mg/l indicates that past levels have been almost twice as large as the present value. The unpublished data of Zafaralla and Associates indicate the possibility of development of even greater hardness is possible as the observed maximum value was up to 400 mg/l in the Cauayan-Sacobia Lake system. The maximum value is close to the maximum permissible limit set out by WHO that is 500 ppm for both surface and groundwater.

9) Heavy Metals

a. Chromium (Cr)

Accumulated chromium is stored largely in the skin, muscle and fat in human body. It can be excreted slowly in the urine and in the feces. When present in high level in water, it can cause skin sensitization according to the AWRC. The degree of toxicity of chromium depends upon the valence of the concerned ionic variety and its synergistic and antagonistic effects with other substances that is modified by temperatures and pH of the medium. Different species of organisms manifest varying reactions to the chromium.

The observed levels in surface and groundwater samples of the Study Area did not exceed any of the standard presented in Tables P.2.5.

b. Iron (Fe)

The concentration of iron in water affects its taste and color. It also produces deposit and growth of iron bacteria. The critical level of iron in the groundwater set by WHO and by Australia is 0.3 mg/l. The Philippine standards for surface water and groundwater are 5 mg/l and 1 mg/l respectively.

Present finding for surface water indicate that only the river water in Dolores, Mabalacat exceeded the standard while that of in Sapang Libutad, which was taken close to a garbage dump had practically reached the limit (see Table P.2.5). Only the artesian well in Sapang Libutad had iron levels exceeding the standard.

c. Copper (Cu)

The human body metabolizes copper, a heavy metal that is not considered a health hazard unless excessive amount is ingested. Human body needs is a daily dose of 1.0 mg/day. Excessive amount of copper in drinking water affects the taste of water. It also leads to corrosion of water pipes. A component of copper is used to treat water in the swimming pool as it is highly effective, at low concentrations, in killing microflora, primarily algae. It is an effective agent to bring about changes in the composition of species in the bodies of water because it could harm the gills of fish and likewise affect on the cell processes and enzyme activity. The toxicity of copper in fish, invertebrates and algae decreases with an increase in water hardness. Larval stages of fish are particularly vulnerable to excessive copper levels. WHO sets out a working level not to exceed 1.0 mg/l in ground water.

None of the presently observed level of copper in either surface or groundwater exceeded the standard level (Tables P.2.5). However, the river in Mabalacat that contained excessive iron levels also carried the highest level of 0.63 mg/l. The rest of the samples noted that they did not go beyond 0.08 mg/l level.

d. Zinc (Zn)

The toxic effect of zinc is known to be reduced by an increase in hardness, salinity and suspended solids. However, it increases with reduction in the amount of dissolved oxygen. It produces sand-like deposits in water pipes and contributes to the taste of water. It is suspected to influence in the manifestation of Alzheimer's disease. Toxic concentration of zinc kills fish by destroying gill epithelial tissue. Chronic effects with zinc in fish also reportedly occur.

The level that adversely affect algae in the range of zinc is from 0.2 to 9.0 mg/l. The toxic level of zinc within the fish body varies from a species to the other. The border is a relatively wide from 0.4 - 5.0 mg to 18 mg/l. The recommended working level set out by

WHO for groundwater is 5.0 mg/l. The values of zinc in the sampled surface and groundwater are on the standard level (Table P.2.5).

e. Arsenic (As)

Arsenic, when ingested into human body, produces chronic toxic effects. It is carcinogenic when present in high concentrations. Level of toxicity depends on the chemical and physical form of the compound and its route by which it enters the human body, dose and duration of exposure, dietary levels of interacting elements, and age and sex of the exposed individual. Lethal concentration of arsenic in the marine animals is at 1 to 10 mg/l. The recommended working level set out by DENR is 0.1 mg/l for surface water. WHO sets out it at 0.05 mg/l in groundwater.

Result of the examination of the sampled water in the Study Area revealed that there has been no detection of Arsenic.

f. Cadmium (Cd)

Cadmium is a highly toxic heavy metal and is associated with severe bone and kidney syndrome. Cadmium interferes with photosynthesis by altering the normal concentrations and proportions of pigments involved in the process. Little is known about its toxicological significance in aquatic organisms. Lethal effects of cadmium arise from the damage caused on the ion-regulating mechanism. Its toxicity increases with an increase in temperatures, and reduction in DO content, water hardness and pH. WHO sets out recommended working level of 0.005mg/l for groundwater. Surface water tested presently did not exceed the standard except in Dolores, Mabalacat where levels were found to be twice the limit (Table P.2.5).

g. Lead (Pb)

Lead is biologically accumulatable. It causes Muscular paralysis, encephalopathy, fatigue, gastrointestinal disturbances and anemia. It also causes an irreversible brain damage especially in children. Its toxicity is known to be affected by hardness and dissolved oxygen content.

Except for San Pablo, Mexico, Bamban, and Tarlac, examined water samples contain lead equal to or in excess of the Australian limit of 0.01 mg/l for surface water, but below WHO standard of 0.05 mg/l (Table P.2.5). Groundwater samples obtained from Sapang Libutad, Dolores and Chico content the level exceeded the Australian standard. Only the groundwater in Cacutud in Mabalacat showed not detectable level of lead.

10) Coliform Content

All of the ground water samples obtained in the Study Area have had total Coliform counts of the colony forming unit (CFU) of exceeding 5,000/100ml (Table P.2.5). Fecal Coliform did not exceed the allowable limit of 50 MPN/100ml for Class GA in most of the obtained water samples except for the fecal contamination in the wells in Culatingan, Concepcion and Sapang Libutad was observed.

(3) Geomorphological Alteration

1) General Topographic Changes

The surface topography near the mountain is generally irregular and gently undulating since this is the place most of the debris piled up. At the distant portion of the lahar field, surface topography is generally smooth and flat since this is the place where debris had been progressively diluted to normal streams and hyper-concentrated flows during the rainy season.

The surface of the flow deposit is covered with thin crusts littered with pebble to cobble sized pumice fragments, armored and non-armored earth balls incorporated with the erosion of older deposits and charred or uncharred plant debris. Successive fillings and undercutting of the active channels have formed most of the lahar terraces (*P-8). Thus, deep gullied river channel, or gorge formation is conspicuous.

On the other hand, the hyper-concentrated flow deposit lacks flow structures except for crude stratification marks with lenses of coarse-grained, cast-supported pumice. The deposits resulting from lake breakouts are well sorted, well stratified and cross-bedded. Along channels where the flows overtopped the banks, well-sorted, cast-supported sieve deposits of pumice fragments are very common. In stagnant areas, such as abandoned channels and interlope margins, alluvial deposits with fine materials are noticeable. This is thickest within the boundaries of lahar channels and lahar-dammed lakes. Thus, the formations of alluvial fan with very gentle slope as well as shallow lake are evident.

2) River Piracy

As a result of Mt. Pinatubo eruption, new drainage is established. These are mainly confined within the pyroclastic flow deposits-filled area in the upper portion of the valleys. This is termed as River Piracy. River piracy has also become common picture especially in the eastern slope of Mt. Pinatubo caused by the secondary explosions. Although there is a tendency for the lahar flow to follow the pre-eruption channels, secondary eruption has caused the deposition of pyroclastic materials in places overlying the channels along the valley, or hyper-concentrated flows break through the pre-eruption ridges producing new channels.

The piracy of the Abacan River has produced large volumes of lahar in the main river channel and extended towards the Sapang Bato River tributary. Consequently, increase in flooding and continuous discharge of pyroclastic material has greatly damaged all of the bridges across the Abacan River destroying thousands of houses in Barangay Sapang Bato River and Angeles City (*P-9)

River piracy drastically changing the course of the Sacobia/Bamban River has occurred more frequently, especially in 1992-1993 period. The Abacan River has repeatedly captured the upstream reach of the Sacobia River by connecting with the Sapang Bato River tributary (*P-9).

During the more recent secondary eruption of Mt. Pinatubo, a small escarpment at the piracy point of the Abacan and Sacobia River has caused degradation of 15-20 meters and facilitated another escarpment 40-50 meters long. This is known as the "Abacan Gap" (*P-9) and the point of branching out of these rivers.

3) Formation of Channels, New Drainage Systems and Lakes

General formation of river channels may include any combination of aggradation, degradation, widening and narrowing and lateral shifting. The type of channel response at a reach is a function of flow magnitude (flow depth and duration), sediment concentration, fluid theology and nature of flow-boundary sediments among others (*P-10). All of these can change drastically during the influx of lahar. The Abacan, Pasig-Potrero and Sacobia/Bamban River and their respective tributaries have exhibited some or a combination of these characteristics after significant amount of lahar has been deposited downstream through their channels.

The Sapang Bato River tributary of the Abacan River initially aggraded allowing lahar to spill into Clark Air Base in the late July 1991 but it then incised roughly 6-8 meters. Older deposits recently exposed in the conveyance reach of the Sapang Bato River valley indicate that after a previous period of downcutting, the channel had stabilized long enough for large forest trees to grow. Farther downstream on the Abacan River in

Angeles City, downcutting has been less severe but vigorous lateral bank erosion has claimed hundreds of buildings due to bank collapse.

During the most recent and minor lahar events, specifically from June to July in 1993, flow along the Sacobia River had resulted in the lateral incision along the southern bank of the channel. This affected the barangays of Macapagal Village and Marcos Village (*P-11).

Channel aggradation along Bamban River has blocked the tributaries of Marimla, Sapang Cauayan and a minor tributary of Sacobia River forming lahar-dammed lake. The biggest of this impoundment is the lake along the Sapang Cauayan.

Over the long term, it is extremely difficult to predict how channels on alluvial fans will respond to continuous high sediment fluxes because the interaction of controlling variables such as flow magnitude, sediment concentration, theology, flow velocity, depth and gradient are not entirely investigated. As long as excess sediment delivery continues, areas of deposition will probably expand laterally and longitudinally in an unpredictable manner (*P-10). In general, a trend of aggradation is expected to occur along the head of the fans where much of the materials are being deposited. When the slope gradient becomes steeper or when the rate of sediment delivery decreases and sediment load declines, it is likely that the fan heads will experience downcutting and re-distribution of the sediments will occur (*P-10).

In as much as processes on the pyroclastic laden channels are active, rehabilitation projects that look into utilization of the lahar-dammed lakes for livelihood projects should be cautious in recommending lake-based projects. These lakes are temporary features that can be easily affected by active processes.

4) Erosion of the River Banks

a. Abacan River

Due to the meandering, the river banks along Abacan River are highly susceptible to erosion, especially bank failure in the Angeles Area (*P-5). Predicted sediment movement will be predominantly the transport of volcanic deposition from the upper reaches to the downstream end of the river. In addition, lateral and vertical erosion is expected to contribute to the volume of flow moved by the Abacan River. Deposition of the sediment load around Mexico may result to high risk of shallow flooding in the area (*P-5).

b. Sacobia/Bamban River basin

Risk of lahar caused by erosion of pyroclastic deposits at its headwater will exist in the Sacobia/Bamban River for the next ten years (*P-5).

Siltation in the river will also be likely a problem at the lower reaches of Bamban River especially in the vicinity of San Antonio Swamp. In fact, widespread siltation in the vicinity of San Antonio Swamp has already smothered vegetation, grasses and agricultural crops. Excessive Siltation may also cause the impounding or shallowing of Rio Chico River that may result to backflooding. Incidence of backflooding apparently took place and inundated at least 10 km^2 after the rain season in 1992 (*P-10).

(4) Soil Resources

1) Physical Characteristics of Lahar

Lahar materials from Sacobia/Bamban and Abacan River basins consist largely of:

- sand (80.4 -95.4 %);
- silt (0.6 - 10.6 %); and
- clay (4.0 - 9.0 %).

At the downstream of the Sacobia/Bamban River at Culatingan, Concepcion, and Tarlac, the lahar deposits are finer and consist largely of silt (53.6 %) and a small amount of sand (20.4 percent) and clay (26.0 %).

The coarse to sandy upstream sediment deposits have a medium to very fast hydraulic conductivity that ranges from 1.2×10^{-4} to 6.5×10^{-2} cm/sec. Bulk density varies from 0.98 g/cu.cm for the loosely structured loamy sand to 1.83 g/cu.cm for compacted loamy sand. Available moisture is very low (1.89 %) to low (6.12 - 8.04 %), except for the lahar material in Dolores, Magalang which is high (23.70%).

The sediments in Culatingan, Concepcion, and Tarlac have poor draining condition due to finer texture with high silt and clay content. Pozzolan is a material containing high amount of reactive silica which reacts with other binding medium in the presence of water to form compounds possessing cement-like properties. The pozzolanic property of the volcanic materials, especially fine-textured material, may hamper agricultural productivity. This is being experienced by farmers in Culatingan, on the hardening or crusting of the sediment when dry.

2) Soil Fertility

a. Abacan River Basin

Table P.2.6 shows the chemical reaction of the lahar material in the six sampling sites, which are shown in the Figure P.2, in the Abacan River watershed. The result ranges from medium acid to slightly acid (pH 5.9-6.6). Organic matter content of lahar sampled from all sites is very low (<1.0 %). Cation exchange capacity is very low (<4 meq/100 g soil). Base saturation of the four sites is moderate (20-60 %) and of the two sites, adequate (>60 %). Phosphorus content of the lahar in Sapang Libutad, Angeles City is adequate (>10 ppm P), moderate (6.0 ppm) for the other site in Sapang Libutad and marginal (<6.0 ppm) for the other four sites. Available potassium is very low (<0.15 meq/100g). Only lahar samples from Angeles City have extractable sulfate for these could be recent deposition. The available micronutrients of Zinc, Copper, Iron and Manganese are very low to low.

b. Sacobia/Bamban River Basin

In Sacobia/Bamban River basin, the reaction of the lahar materials in the five sampling sites, shown in the Figure P.2, ranges from medium acid to slightly acid of pH 5.7-6.7. Organic matter content is very low, except for the sediment from Culatingan in Concepcion which is moderate of 1.46%. Cation exchange capacity is very low, except for the lahar material in San Vicente in Concepcion which is moderate of 9.37 meq/100g of soil. Base saturation is moderate, except for the sediment in Culatingan which is adequate of 65.35%. Phosphorus is low, except for the sediments from Culatingan and San Vicente which are moderate of 8.8 and 9.71 ppm respectively. Available Potassium is low, except for the sediments in Culatingan and San Vicente which are adequate of 0.34 and 0.26 meq/100 g respectively. Only the soils in San Vicente and Dolores in Magalang have shown some content of extractable sulfate of 58 and 830 ppm SO_4

respectively. The lahar material in Dolores is a recent deposit. Its micronutrient level on Zinc, Copper, Iron and Manganese in most of the samples obtained in the Study Area are low to very low. The lahar deposit in Culatingan and San Vicente have adequate amount of copper and iron.

Lahar in the Sacobia/Bamban and Abacan River basins are low in natural fertility, except for the sediments in Culatingan and San Vicente, Concepcion, Tarlac which are moderate.

Thin layer of ashfalls (<10 cm thick) when incorporated into the soil by plowing has a favorable influence on the rejuvenation of underlying layer of soils with a supply of plant nutrients. Ashfalls of Mt. Pinatubo contain large amount of feldspar which is easily weatherable mineral and contributes to the formation of secondary mineral and a source of supply for Ca, Na and K (*P-9).

2.2 *BIOLOGICAL ENVIRONMENT*

(1) Wildlife

There are eight sampling sites, while two others were located outside of the Study Area but within important secondary impact areas (Figure P.3). The Transact I for wildlife observation was in Sapang Bato River near the major lahar deposit in the upper reach of Abacan River. Transact II starts from Capaya Bridge and two kilometers inland. Transact III is located starting from San Juan Bridge towards the town of Mexico. Transact IV is located in Talimundoc in Tarlac towards the confluence of Bamban River and Rio Chico River. Transact VII is located in Sitio Mainang, above the evacuation center of Dapdap and Pandan of the town of Bamban in Tarlac. Transact VIII is located in the proposed sand pocket area along the dike from San Francisco Bridge.

The two sites outside of the Study Area are located in Masantol and Candaba in Pampanga. Transact A follows the dike along Pampanga River in Masantol towards the estuary of Pampanga Bay. Transact B is located along the dike traversing the Candaba swamp, close to Pampanga River.

In Transact I, Sapang Bato River, Angeles City, a wildlife inventory made by GIRD Foundation reported that there were several species of snake in the area. However, no snakes were observed but a few lizards. The absence of snakes indicates that ground dwelling terrestrial wildlife have been affected by the Mt. Pinatubo eruption. Snakes may have been covered and probably killed by hot ashfall during the eruption. Those that may have survived would have difficulties looking for food as their prey might have disappeared. In the lower portion of Sacobia/Bamban and Abacan River, where large scale flood event have been taking place, have caused to move snakes from the original territories. The reproduction rate of snakes are relatively low. Thus, regeneration of them in the area should take very long period of time.

Before the eruption of Mt. Pinatubo, there were 52 species of bird species observed in and around the Clark Air Force Base. On the other hand, there are only 40 species recorded during the study period. Most of the species disappeared from the Study Area migratory ducks, pochards, and shorebirds. These species has been sighted in Candaba Swamps as late as 1981. The Spot-billed Pelican (Pelecanus philippinensis), Spoonbill (Platelea minor), and Shelduck (Tadoran tadorna) may have been exterminate in Luzon even before the eruption of Mt. Pinatubo. However, the migratory aquatic birds and shorebirds may have been affected by the gradual deterioration of their habitat after the eruption.

Distribution of wildlife in the study area has been limited to small mammals such as rodents, reptiles, amphibians and bird species. Present measures to construct a series of sabo dams would increase number of snakes, lizards and frogs as the voids between stones held-up with chain link nets should provide habitats for them.

(2) Bird Species in Candaba Swamp

Candaba Swamp is known to the area of intermediate resting place on the corridor of Pacific Flyway for migratory bird species. There is no evidence nor experiences on the significant effect on them has been known to date. Since the swamp is not the permanent breeding ground for protected species of birds, significant long term study on them has been conducted. Thus, this is a subject to further study and monitoring works.

During the rainy months that coincide with the typhoon season, the water in Candaba swamps normally rise above its normal level and sometimes result to flood. After a period of two to three weeks, the water subsides leaving mudflats, which attract aquatic birds and migratory shorebirds. They normally feed on insect, larvae and earthworms that are abundant in the muddy substratum. Aquatic birds also feed on the algae bloom and small aquatic plants.

In the last two years after the Mt. Pinatubo eruption, the soil and mud in Candaba swamp, rice fields and fishponds are slowly covered by lahar deposit brought in by flood waters of Rio Chico and Pampanga River. Every year, the layer of lahar deposit is getting thicker. As a result normal channel of Rio Chico River, one of the major outlets to Pampanga River, has been clogged up with lahar materials. Flood water during the rainy season therefore do not flow toward the Pampanga Delta as Rio Chico River blocks up the normal flow of Pampanga River but stays in Candaba Swamp for a much longer period.

The slow subsidence of the water in Candaba Swamp enhances sedimentation of the lahar materials over the indigenous soil and mud. Therefore, plant and aquatic species that are fed by birds have been affected. Despite the fact that Pampanga Delta is a vast flat area and its drainage is very poor, accumulation of lahar materials in the stream bed in the Pampanga Delta should have been taking place since the eruption of Mt. Pinatubo. This should eventually affect mangrove areas on the edge of Manila Bay over a considerably long period of time.

Layers of lahar material with poor organic content have accumulated over the organism-rich mudflats will be devastating to the shore birds as they cannot feed on in the area. Provided that this is the case, migratory birds and aquatic birds should avoid and skip Candaba Swamp and Pampanga Delta. The alternative areas are not known at the moment. Extensive study on the population and destination of migratory birds in the Candaba Swamp and Pampanga Delta requires international effort, which will be the most difficult task of this kind.

Candaba residents said that despite the fact that there are decreasing number of water birds and shorebirds in Candaba Swamp even before the eruption, the decrease of bird species in the area during the last two years was noticeable. In the past, the decline of water birds and waders were due mainly to over-hunting and conversion of swamp areas into fishponds which deprived the breeding ground for the birds.

(3) Flora

1) Vegetation Growth in the Study Area

a. St. Rosario

In the extensive area covered by lahar materials, talahib grass grows rapidly and this is evident along river banks. The slopes planted formerly with crops but left idle since Mt. Pinatubo eruption were invaded by weeds, herb, shrubs, and vines, mainly legume families. Woody species such as kakawati (Gliricidia), kamatchili (Pithecellobium) and katuray (Sesbania) serve as field borders and fences. Datilis (Muntingia) and Anabiong (Trema) are occasionally seen in affected areas.

On the extensive area completely covered by thick lahar, no plant species has come up yet.

b. Barangay Margot

Talahib grass is covering the ground in the area where lahar deposit piled up to several feet deep. Common weeds and grasses of leguminous species are covering the ground in the hill slopes previously planted with corn, gabi and vegetables. These weeds are the commonly encountered weeds of cultivated lands.

c. Sabo Dam and vicinity along Kamayan River

The area around the Sabo Dam is located is an open grazing land or waste land. Vegetation growing in the area belongs to several families of Parosela, Lantana, Chromolaena, Sida and leguminous shrubs and vines.

d Bamban, Tarlac

River banks widened by lahar deposits were invaded by talahib grass. Abandoned croplands were invaded by weeds. Growing with the talahib are some shrubs like Sida and two species of legumes such as Crotalaria and Indigofera.

e. Culatingan

Extensive dikes have been are constructed to prevent lahar flow in Culatingan. Talahib and Phragmites are growing in the area affected by lahar including dikes.

f. Sapang Bato River

Apart from talahib, there have been more that 10 species of grass species observed in the area along Kabaan River. Dominant species are hagonoy (Chromolaena), Bikas (Mikania), and Wild Sunflower (Tithonia) and others. Several species of ferns were observed although they usually grow on shaded ravine. No weed species are growing on the cultivated and wastelands.

Woody species seen on the exposed hill slopes are Muntingia, Trema, Macaranga, Streblus and Pithecellobium. There are more than 15 legume species recorded.

There are a cluster of huts of the Aeta in the adjacent hillside, whose elevation is 315 m asl. The area is planted with banana, vegetables, fruit trees. Woody species are planted as fence. Other type of trees are also planted on the boundaries of plots such as Sesbania, Bauhinia, Gliricidia, Tithonia, Bridelia and Ardisia. These are the common shrubs and trees grown in this area.

g. Barangay Talimundoc

Barangay Talimundoc is in Concepcion, Tarlac and its elevation is 25 m asl. There is an old irrigation dike constructed during the Marcos Era. There are mature trees of introduced species planted on both sides of the dikes such as Leucaena and Gmelina. On the wet banks are Talahib and Phragmites. There are few grass species, more of legumes and species of several families. Woody species are Trema, Muntingia and Macaranga.

h. Pampanga River Delta

Average elevation of the northern edge of Pampanga Delta is 15 m asl. Water stands all year round on both sides of Pampanga River. Fish culture and duck raising in ponds in the Delta are very popular. At higher grounds, vegetables and other cash crops are grown. Dominating weed species are common grasses and sedges as well as other species typical to lowland plant community.

i. Candaba Swamp

Elevation of the Candaba Swamp is around 40 m asl. Extensive area is under water during rainy season and the area is utilized for fish pond in the wet season. During dry season majority of the area is utilized for growing squash species of melon, cucumber, watermelon, etc. The area is also a major rice growing area during the dry season. Thus, dominating plant species in Candaba Swamp are agricultural crops although there are weeds and scrub species on the fringe of agricultural areas and on the dikes.

j. Sitio Mainang

There is a evacuation center in Sitio Mainang and the site is on the rolling terrain. It is an extensive open area with typical grazing plant species.

2) Changes in Vegetation in the Lahar Affected Area

There is no primary vegetation area classified as primary growth area of tropical rain forest in the Study Area. Secondary vegetation area is mostly on the steep slope of the riverside above the alluvial fan. On the other hand, the area affected by lahar deposit is primarily agricultural area. Thus, damaged vegetation over extensive areas in the Study Area can be divided into two different areas:

i. Secondary vegetation growth area not extensively damaged;

ii. Agro-ecological area extensively damaged.

The eruption of Mt. Pinatubo has changed the landscape of the Study Area. It also caused extensive damages to the cultivated area Sacobia/Bamban and Abacan River basins. Ashfall and lahar deposition have affected growth and development of plants in the vast area including the Study Area. However, secondary vegetation area is very rapid to rejuvenate its original vegetation. On the other hand, there is a complete alteration of vegetation in the agro-ecological area.

The first plant species that come out in lahar deposit area is Talahib (Saccharum spontaneum) and it colonizes almost entire area where plant species are completely damaged. Characteristics of Talahib is robust perennial with vigorous rhizome and an extensive root system. Talahib is found in the low lying areas or periodically flooded sites, from alluvial plains to the foothills up to 1,500 m asl.

In flooded and wetlands, Talahib is associated with Tambo (Phragmites karka), a tall reed grass whose dried inflorescence are made into soft broom. Ground moisture is perennial and the growth of the two species can be observed in the area after the harvest of seasonally flooded rice fields, farmlands and irrigation dikes.

Leguminous species (Calopogonium) is another plant species that dominate the landscape of the Study Area. Often times it grows near and clings over Talahib. In some lahar affected areas, particularly in Bamban, formation of the grass in clustering or spreading in centrifugal patterns on sand is common or merges with other plant species. Associated with Leguminous species are Indigofera and Mimosa.

The dikes constructed on both sides of Pampanga River provide attractive habitat for grasses and herb. Several legume species commonly grow in the wasteland and open grazing land. Wherever the soil containing seeds and propagules came from, their roots are provided with healthy nodules with ground moisture. Legumes are species of ecological importance due to their symbiotic association with Rhizobia in nodules and also the agent of nitrogen fixation for most of the plant species.

The colonization of grasses (Saccharum and Phragmites) on bare lahar deposits and their association with leguminous species signifies an early stage of natural regeneration process of the localized micro-ecology. With continuous build up of the grass species in the micro-environment, consequent progression of other plant species eventually support the growth and development of shrubs and the pioneer tree species as well as insect, wildlife, birds, and even human species.

In the foothills of Mt. Pinatubo, Talahib is associated with Hagonoy (Chromolaena odorata) considered as poisonous to livestock but a good composting material. Along ravines, Talahib is also associated with widely grown species of wild sunflower (Tithonia diversifolia), a species rated efficient for soil moisture retention and fuel when dried.

At alluvial plains, 15% of species are constituted by legume and this group are known for their ability to rehabilitate marginal areas. Commonly occurring species are members of Crotalaria, Desmodium, Indigofera, Tephrosia, Calopogonium, Centrosema, Flemingia and Dalea (formerly Parosela).

2.3 *SOCIAL ENVIRONMENT*

(1) Land Use

1) Changes in Economic Activities

With the change in land use conditions due to the damages made by lahar and its deposition, the land use in the Study Area has already been changed. Commercial and industrial establishments, houses, buildings, farmlands, infrastructure, forest, grassland and the river systems were severely damaged. Clark Air Force Base was abandoned by the US Air Force immediately after the eruption of Mt. Pinatubo.

The upper watershed of Sacobia/Bamban and Abacan River basins were covered with thick ashfall. Extensive area of farm lands and residential areas along Sacobia/Bamban and Abacan River have been covered by 1991-1993 lahar deposition. The national highway including bridges linking Mabalacat and Bamban were destroyed and covered with lahar deposition. Bailey Bridge along Highway 329 was damaged by lahar in recent years. San Francisco Bridge also on the Highway 329 is being threatened by lahar in Sacobia/Bamban River.

The lahar/lahar affected areas from 1991 to 1993 in Sacobia/Bamban River basin was about 11,575 ha and 2,930 ha in Abacan River basin. The estimated total lahar hazard areas including those affected by lahar deposition and Siltation as well as flooding have been in the range of 23,100 ha for Sacobia/Bamban River basin and 4,060 ha for the Abacan River basin. Approximately 180 ha of commercial/residential areas have been badly affected by lahar on 1991.

Barangay San Martin and Sta. Rita have been covered with thick lahar deposits. The low lying area is prone to further deposition if the existing dikes are breached. Breaching dikes could threaten the agricultural and built-up areas.

Talahib grass is growing on the lahar deposit at the moment. Approximately 1,900 ha of farmland in Bamban and 800 ha in Concepcion was affected by lahar. In Barangay Culatingan alone, 300 ha of rice field has been covered with lahar. This has made the Barangay Culatingan and Cafe built protection dikes in order to save their farmlands from flooding and Siltation.

The rice field between Sacobia/Bamban River and the dikes in Barangay Cafe and Culatingan is covered with 2-3 m Talahib grass at the moment. Table P.2.7 shows the effects of lahar deposition on reduction of agricultural land uses.

2) Infrastructure

The barangay road from Balutu to Talimundoc is inaccessible to vehicle because the road is flooded and the wooden bridges are badly damaged. The settlements of Barangay Telebangca, San Nicolas Balas, San Roque and Navaling are prone to further lahar. Some sections of Highway 329 is lower than the lahar deposit between San Francisco Bridge and Barangay San Roque.

All the bridges across the Abacan River upstream of Mexico have been damaged including five national highway bridges in Angeles City. Abacan Bridge was destroyed by lahar in 1991 and rebuilt it in 1992. San Francisco spillway, Sapang Bato River Bridge and Pulung Maragul Bridge in Angeles City were also destroyed. Breaching of the dike at Kapaya I in Mexico caused flooding and lahar deposition on the adjacent farmlands. Flooding occurs downstream of Abacan River in Mexico because Bungang Guinto Creek is heavily silted and it needs dredging to enhance the flow of flood water.

The bridge linking Mexico to Arayat was elevated in order to avoid further lahar. Bank erosion in Angeles City destroyed residential establishments and the road to Barangay Sapang Bato River along the perimeter of Clark Air Force Base.

3) Commercial Area

Angeles City is part of the growth triangle in Central Luzon. Clark Air Force Base is classified as Special Economic Zone. The abandoned airport of Clark Air Force base is envisioned to be a new international airport complex and that it should service for international commercial flights to and from the Philippines. The Clark Air Force Base covers 1,689 ha of grassland. Several foreign investors have selected to put up their industrial establishments in the industrial park adjacent to Angeles. Tourism, commercial and residential programs are part of the Angeles City - Clark Air Force Base economic nodal point.

Mexico is in the process of transformation to become urban center. It is an area where industries and commercial and business enterprises concentrate, mainly expanding from San Fernando and Angeles.

4) Future Land Use Potentials

The lahar formed a lake at the exit of the Sapang Cauayan River and Marimla River. It could be used for water-based recreation, aquaculture and/or irrigation. The affected barangays in Sacobia/Bamban River basin have been 12 in Mabalacat, 7 in Magalang, 15 in Bamban and 45 in Concepcion.

The lahar deposit along Abacan River has been excavated and used in various construction sites as far as Metro Manila. Leveling of the excavated lahar deposit along the dike enhances the utilization of the area for lowland rice or upland crop production such as sweet potatoes or cassava. Inadequate maintenance of the Sabo dam and bank stabilization should trigger further bank erosion and the loss of agricultural land along Abacan River.

(2) Agriculture

1) Farming Activities in the Study Area

a. Tarlac

i. Bamban

Agricultural areas of Tarlac which occupy 46 percent of the total provincial area now represents 43 percent after the Mt. Pinatubo eruption, a decrease of 8,489 ha. Out of 8,489 ha, 5,754 ha have been submerged by pyroclastic in 1991 and 1,930 ha have been added in 1992 in Tarlac.

The municipality of Bamban is one of the most hard hit areas by lahar in Bamban River. As a consequence, agricultural land use was reduced to 9,183 ha in 1993 from 11,439.12 ha in 1990. On the other hand, use of the land for fishery increased to 185 ha in 1993 from 15 ha in 1990.

Fishery production was not significantly affected in the town and the fishponds are remaining undamaged and yield has not declined after the eruption (Table P.2.9).

Farmers within the barangays of San Pedro, Annupul, Dela Cruz, Culubasa, Pacalcal and Bangcu have initiated the rehabilitation of 115 ha of land submerged by lahar deposit. For rice, an average yield of 3,600 kg to 4,200 kg/ha/year has been obtained with the aid of 4 to 6 bags of urea per ha, deep plowing and deep well irrigation. Certified rice seeds have been provided by the municipal agriculture office under the grain production and enhancement program. Sugarcane, sweet potatoes, peanut and leafy vegetables were likewise planted as part of the strategy.

ii. Concepcion

Concepcion is one of the badly affected areas and its 36 percent of the total rice production area has seriously been damaged. Twenty five barangays in Concepcion suffered from severe devastation. Concepcion has now a target of which 5,952 ha of agricultural area should be rehabilitated, and out of which 5,404 ha is proposed to be irrigated (see Table P.2.10). Farmers in two separate areas have started initiating a community head approach to rehabilitating their areas.

In Barangay Lilibangan, the farmers cooperative and barangay council have initiated planting RC 14 variety of rice in 29 ha. Average yield resulted to 4,800 kg per ha in only one crop per year with irrigation and application of compost.

As a source of additional income, the farmers raise ducks from 200 to 1,000 heads per family for their eggs and for cash sale outside Lilibangan. The rehabilitation activities in the barangay are expected to infect nearby Barangays of San Martin and Sta. Rita.

Farmers of Barangay Culatingan, on the other hand have also initiated reviving 30 to 45 ha of former agricultural land submerged under 1- 6 feet of lahar deposit. Farmers in Culatingan have applied 16 bags of 50-kilogram compost per ha, 2-3 bags of urea and 3 bags of chemical fertilizer. As a result, average yield of 5,100 - 5,400 kg/ha/year on the 2 to 3 feet of lahar deposit have been obtained. This is compared to the average yield of 3,000 kg/ha/year in areas under 1 foot of lahar.

Likewise, about 350 kg of camote have been harvested in 625 sq.m of land on the 2 to 3 feet thick of lahar deposit with an aid of one half bag of urea and 1 bag of organic fertilizer. Peanuts average a yield of 400 kg (shelled) with the aid of 3 bags of organic fertilizers applied to an area of 625 sq.m. In addition, mango yielded 420 kg to 480 kg with an aid of organic fertilizer and chemical pesticides.

Trials with watermelon using the basket technology of planting with then aid of organic fertilizers did not succeed. The method refers to planting the watermelon in a pit and mixed with organic fertilizer. Watermelons planted in deeply plowed areas with organic fertilizer, urea and complete fertilizer applications were successful.

b. Pampanga

i. Municipality of Mabalacat

Agricultural areas previously representing 52 percent of the total provincial area in Pampanga now represents 46 percent of the total land area, a decrease of 12,368 ha. Out of 12,368 ha, 3,939 ha have been completely covered by pyroclastic materials.

The actual area devoted to irrigated paddy rice in Mabalacat after the Mt. Pinatubo eruption is 637 ha and rainfed paddy rice area of 316 ha. Rice production averages 4,800 kg per ha in irrigated area and 4,200 kg per ha. Green corn is planted in 55 ha yielding 3,000 kg per ha, mango in 31 ha, peanut in 68.5 ha, sitao in 10 ha, sweet potatoes in 308 ha, cassava in 18 ha, garlic in 37 ha and radish in 68 ha.

After Pinatubo's eruption, production areas for major crops in 8 barangays damaged by lahar significantly were wiped out. Farmers in Dolores have claimed that they obtained a yield of 10,000 kg/ha/year of rice before the eruption of Mt. Pinatubo. Now, about 500 ha of rice field submerged under 20 to 25 feet of lahar deposit (see Table P.2.11).

Barangay Bundagul farmers cultivated average 1.5 ha of rice field yielding average 6,000 kg/ha/year with the aid of urea and ammosul as fertilizers (see Table P.2.11).

Farmers in Kisyo are aggressive to revive their farmlands, despite the fact that a part of their 200 ha submerged under 5 - 20 feet of lahar deposit. Deep plowing and 4 sacks of urea aided the growth of rice in this area the yield of 6,000 kg/ha/year and some sweet potatoes.

Paralayunan, located in the secondary impact zone, affected by ashfall and soil pollution coming from the waste water of a nearby paper mill yields about 2,100 kg of rice per ha as compared to the average yield of 4,800 kg/ha/year (Table P.2.11).

ii. Municipality of Magalang

Some 6,921 ha of agricultural land in the municipality of Magalang are planted to various major crops, with which the irrigated paddy rice covers 3,313 ha. About 4,178 farmers are depending on farming, which also plant some root crops such as gabi, sweet potatoes, cassava, legumes and vegetables. Livestock, poultry and duck raising are very popular, while hogs, carabao and cattle raising are of secondary importance.

At present, there are five barangays damaged by lahar but are active in planting 1,538 ha of various crops. Irrigated paddy rice occupies 855 ha and rain fed rice paddy is 156 ha. Sugarcane is allotted for 363 ha while 0.15 ha is occupied by fishpond.

iii. Municipality of Mexico

Extensive damage on agricultural areas in Pampanga likewise reached 3,255 ha in 1991 and another 2,022 ha have been added in 1992. This affected a total of 2,365 farming families in Mexico (Table P.2.8).

Of the Mexico's total area of 15,339 ha, irrigated paddy rice occupies 4,664 ha and rain fed paddy rice is 11,144 ha while sugarcane is allotted for 2,046 ha.

About 4,362 farmers depend on agricultural production for their main source of income which include cultivation of rice, root crops, vegetables and other crops.

Farmers also rely on livestock and poultry production concentrating mostly on raising 400,000 heads of broilers, 50,000 heads of layers, 10,000 heads of ducks and 7,000 heads of hogs. Carabao are 3,576 heads, goats are 2,000 heads and cattle is 450 heads.

There are 15 barangays whose agricultural areas are affected by lahar amounting to 1,524 ha. The lowland areas are under 6 feet of lahar deposit while the upper areas are affected by 6 inches to 1 foot lahar deposit. All of the damaged areas are being rejuvenated with deep plowing, scraping and application of organic fertilizer.

Damaged farmlands planted with rice would produce average of 4,800 to 5,400 kg/ha in one cropping.

In Barangay San Pablo, farmers produce average 4,800 to 9,000 kg/ha/year before Mt. Pinatubo eruption aided by 2 sacks of urea and 2 sacks of ammosul. Under the present conditions of the soil submerged under 3 feet of hard and compacted lahar deposit, the same farmers in the barangay have no means to recover the agricultural activities (Table P.2.11).

iv. Municipality of St. Ana

St. Ana's total land area of 4,518 ha is cropped to 1,247 ha of irrigated rice, 2,094 ha of rainfed paddy rice, 277 ha of sugarcane, 153 ha of orchard and 107 ha of fishpond. The 2,838 farming families depend heavily on the crop production for their living. They also raise about 377,181 heads combined of livestock and poultry.

There are 6 barangays damaged by lahar. However, there are agricultural areas presently cultivated for irrigated paddy rice of 519 ha and rainfed paddy rice area of 859 ha. A total of 1,379 ha are being rehabilitated for crop production.

v. Municipality of Angeles

At present, Angeles City's function is being developed towards industrial and commercial center. Despite this, about 825 ha of land in Angeles is planted for sugar-cane. There are 155 ha of irrigated paddy rice, 147 ha of cassava, 103 ha of sweet potatoes, 47 ha of vegetables, 53 ha of to orchards, 15 ha of corn and 88,200 ha of fish ponds (Table P.2.12).

2) Crop Production

Rice remained as major crop raised in Pampanga and Tarlac even after the eruption of Mt. Pinatubo. Although rice is the major agricultural commodity in Pampanga, the area planted in the irrigated paddy rice area has been decreased from 56,874 ha to 42,939 ha and the rainfed paddy rice area from 25,140 ha to 22,394 ha. On the contrary, the production areas for sugarcane increased from 22,089 ha to 29,796 ha after the Mt. Pinatubo eruption. Other cash crops such as corn, stringbeans, cassava and mixed fruit trees have also been planted despite the eruption (Table P.1.42).

In Tarlac, irrigated paddy rice areas decreased from 59,328 ha to 46,150 ha. On the other hand, rainfed paddy rice area has increased from 52,236 ha to 52,620 ha and sugarcane area from 20,496 ha to 20,887 ha. Tarlac has maintained its production areas of corn, eggplant, mango, mixed fruit trees and tobacco (Table P.1.42) as before.

3) Livestock and Poultry Production

Three of the six major livestock and poultry animals raised in Pampanga increased in production after the Mt. Pinatubo eruption. Production with cattle increased from 4,080 heads in 1990 to 4,505 heads in 1991 heads, hogs from 156,970 heads in 1990 to 166,991 heads in 1991, and goats from 11,390 heads in 1990 to 46,860 heads in 1991. Carabao productions decreased from 31,570 heads in 1990 to 30,224 heads 1991, chicken from 2,767,980 heads in 1990 to 2,597,880 heads in 1991 and duck from 260,320 heads in 1990 to 256,280 in heads 1991 (Table P.1.44).

In Tarlac, hog production increased from 118,020 heads in 1990 to 154,230 heads in 1991 and ducks from 508,700 heads in 1990 to 843,530 heads in 1991. Carabaos raised decreased from 64,350 heads in 1990 to 51,772 heads in 1991, cattle from 37,790 heads in 1990 to 28,945 heads in 1991, chickens from 1,204,890 heads in 1990 to 930,790 heads in 1991, and goats from 59,820 in 1990 to 46,860 heads in 1991 (Table P.1.44).

(3) Community Perceptions on the Mt. Pinatubo Eruption

1) Areas Severely Affected by Lahar

The area received the most devastating damages from the lahar as a result of the Mt. Pinatubo eruption is Bamban and Concepcion on the left bank of Sacobia/Bamban River. The residents in the devastated barangays of San Martin and Sta. Rita claim that heavily silted water flowed into their agricultural land as early as June 12 1991. As they used to be the early flooding of Parua, they were not bothered by the flood of the river. They were shocked, however, when dense lahar buried Barangays San Martin and Sta. Rita on July 22, 1991. While the two barangays were completely covered, the fields in Lilibangan, Magao, Castillo and Culatingan were also inundated in varying degrees.

The same major lahar flow submerged parts of Minane near Sta. Rita and portions of the agricultural lands in Dungan and San Francisco on the upper left bank of the Parua River. In addition, sections of Balutu, Talimundoc, Marimla and Panalicsican on the lower right bank of Sacobia River were also inundated. As in the case of barangays in the lower left banks of Parua, the broken portion of the dike in Dungan and Balutu, respectively, is the evidence of the dikes breached and inundated the residential area and agricultural land.

Lahar flows which entered the opening of the dike in Sitio Gomez surged through the Lucong River and blocked its channel. As a result, the river changed its course and headed towards the barangays of Malupa, Cafe and Culatingan on the way to the Rio Chico de Pampanga. The new river course washed away houses and other structures in

Barangay Malupa silting agricultural land and those of the adjoining barangays of Cafe and Culatingan.

It is noteworthy that the new channel created by the meeting of the Parua River and Lucong River flown directly into Barangay Malupa's main street. Residents pointed out that the new course was once an old river channel which was made use of the street as the river dried up.

The breach of the dike in Tabun, Mabalacat, Pampanga and Malonzo in Bamban channeled the flow to Telebangca, San Nicolas Balas, San Antonio and Calius Gueco. Parts of San Vicente, Balutu and Talimundoc Marimla were also affected by the lahar flows of the main Parua channel.

The meeting of the Lucong and Parua Rivers was only one of the changes wrought by lahar on the existing water channels in Concepcion. Because of the heavy siltation in the upper portion, water originating from Sacobia/Bamban River diverted to other tributaries in Barangays of San Pedro and Bangcu in Bamban, and to the many small streams flowing through Sapang Minane in Sitio Ligaya, Barangay Santiago and Sitio Macangcong, and Barangay San Francisco. The swelling of the river channel of Sapang Minane accounted for the floods in the Concepcion's town proper in October, November and December 1991 and in January 1992.

Water originating from the Sacobia/Bamban River which formerly fed the original course of the Parua River diverted much of its flow to the low lying areas on the right bank of the lower Parua River. These included San Nicolas Balas, San Antonio, San Bartolome, San Isidro Almendras and Panaticsican, as well as the small tributaries flowing through the municipality of Magalang in Pampanga.

There are 9 barangays in Mabalacat, 14 in Angeles City, 21 in Mexico, 12 in Bamban and 19 in Concepcion. Members of the most severely affected households have been resettled in different resettlement centers. Dueg in San Clemente, Tarlac is the largest evacuation center for upland residents accommodating 2,000 families. Pandacaqui in Mexico and Dapdap in Bamban are the evacuation center for lowland residents and relatively larger than the others. They accommodate 5,280 and 4,500 families, respectively.

2) Community Perceptions

a. Pampanga

i. San Lorenzo in Mexico

With the lahar flow of 1991, heavy Siltation occurred clogging the Betis River and the Abacan extension. As the exit of these two rivers could not contain the volume of silted water, the whole community became lower than the river. The flood occurs every year since the eruption of Mt. Pinatubo. They have hampered the community life in San Lorenzo and have frustrated them as farmlands have been flooded. Consequently they earned no income.

Their life is "as watery as their environment" relying on relief and going to places to find jobs without assurance of where to find the next meal for their families. The discomfort of the life and the fear of rains have greatly affected the socio-cultural environment of the community. The situation have consequently caused various degree of psychological stress among the residents particularly women.

Included here are some statements of the residents about the value of their land. "My land is like gold because it is the source of our livelihood. Now, that it is covered by water, it is as if half of our lives have been taken away". "The value of our land is the value of our lives, take it away and we will die". As it has been four years that their farms have been underwater, anything that will take the water away is welcomed. The Barangay Captain indicated that the whole barangay is one in their decision to give manpower and time to put to end the source of all their miseries.

The government assistance to pay the houses that were destroyed has not been fulfilled. There are no livelihood projects in the evacuation centers. Members of relocated families have to go far to find jobs.

ii. Barangay Sapang Bato

Being the barangay closest to Mt. Pinatubo, the residents called the experience a nightmare. Heavy ashfall and the threat of lahar eating away the river banks drove 70% of the population to a safer place. They lost jobs as Clark Air Force Base was closed. As a result what was once a flourishing community became desert. Today only the native Kapangpangans are left with a few migrant workers rebuilding slowly with what is left.

iii. Barangay Cacutud

The experience of lahar traumatized the residents for never in their life they would experience such devastation, particularly on their farmlands. After the eruption, people went around daze and with great fear that their whole life has gone. Although their homes were spared, they were warned to leave the barangay as it was threatened by further lahar and flood. Most of the residents of the barangay are farmers with no other source of income but the farms.

The residents of the barangay were resettled at the Mawaque Resettlement Center and came back only to the barangay if it were safe. Their only request is that livelihood fit to their capability be given them because they do not want to be beggars.

b. Tarlac

i. Bamban

The general perception of the people affected by lahar was an ambivalent feelings on the lost properties and helplessness. "After the incident, people suffered a degree of shock - they could not believe that Bamban was submerged, knowing that its location is high and no recorded history of flooding in the past. Our houses have submerged when in fact it was high - that was the place where we were born, grew up and knew life, but now it is gone forever, how can this happen?" Suffering from the trauma they respond with a hope that "God will see them through all these".

"Never Say Die Bamban" is the slogan today among the community members. Although the town has been declared as high-risk area, any effort to save Bamban is welcome by the members of Bamban community. They promised to give themselves human and material resources in order to recover their beloved town.

The Dapdap Evacuation Center was established by the Mt. Pinatubo Commission with the help of Provincial and Municipal Government for the lahar victims of Bamban and neighboring areas whose homes and livelihood have been devastated. The Dapdap Evacuation Center has an elementary and a high school.

The basic problems in the evacuation center are the lack of housing units and livelihood program. Most of the resettled people are either farmer or former employees of Clark Air Force Base. When Mt. Pinatubo erupted, the farmlands were covered with ash. When the Clark Air Force Base pulled out of the Philippines, the employees became jobless. Although the Department of Trade and Industry tried to respond to their needs, the evacuees had fallen short in matching the requirement of the skills. There were also not the enough income generating projects. As a result, a number of residents had to move out to as far as Manila to find jobs.

ii. Concepcion

Much to the dismay of the residents, the municipality of Concepcion has been identified as a retarding basin for the volcanic debris accumulated on the eastern slopes of Mt. Pinatubo. Of its 45 barangays, 29 are located along the banks of the Parua, Lucong, and other rivers of Tarlac which are linked to the Sacobia/Bamban and O'Donnell River systems. Since Parua is merely another name for the Sacobia/ Bamban River when it reaches Concepcion, it stands to reason that a lot of the parts of the municipality would be severely affected by lahar.

The resettlement area for affected communities of Concepcion is Camp O'Donnell. The resettled families still return to their communities during safe days. The major problems of the evacuation centers are the lack of livelihood programs and its distance to the workplace.

(4) Ethnic Minority

1) The Aeta in the Evacuation Centers

The Aeta resettled in evacuation centers expressed their concern over the cultural disorientation in relation to the unfamiliar living conditions. Flat lands were strange compared to their upland homes. They hope to return to the mountains in communion with nature and their God as early as possible. They believe what their ancestors said to them that Apo Namalyari, their god, lives on the mountain and "still stands in the depths of their hearts" although it may have "vanished from their sight." (*P-12).

At present most of The Aeta of the Sitios of Sto. Niño within the area of the Sacobia Development Authority have returned. The Aeta of Marcos Village have resettled in the near-by hillside of Malutung Gabun and found the place relatively safe from the onslaught of lahar and flood. Likewise, the Aeta of Sapang Bato River have also returned to their village which they say is their home. They find the location of their village relatively safe.

2) Bamban Aeta

There is an organization called "Bamban Aeta Tribal Association Inc." which has been incorporated on November 20, 1992. They then made a request to DENR for the recognition of their ancestral land/domain of 3,900 ha in Bamban and Tarlac. This area covers from the south of Mt. Pinatubo, the Sacobia river, up to SDA Gutierrez Line, the Sitio Malagpo-Mainang, Sitio Mabilog up to Sitio Gayaman; to the North Sitio Canuman, Sitio Mauricia, Sitio Malaza, Sitio Bagingan, Sitio Uybo, Sitio Magube, Sitio Morales up to Mt. Gata; to the West starting from Mt. Gata to Mt. Pinatubo on the boundary between Zambales and Tarlac. The area within these boundaries is declared as the former tribal territory belonging to The Aeta of Bamban.

P.3 ENVIRONMENTAL IMPACT ANALYSIS

3.1 PHYSICO-CHEMICAL ENVIRONMENT

(1) Soil Resources in the Agricultural Area

Containing mudflow and its deposition into the diked course of river would protect soils of the adjoining prime agricultural lands from further deposition of volcanic materials. Thus, the structural measures of the Project should protect present soil fertility and that the agricultural activities for planting sugarcane, rice, root crops and vegetables can resume as soon as, and as safe as, possible.

(2) Geomorphological Changes

1) Diking

Diked course of river would reduce erosive power of the river. The dikes and other structural measures of the Project should hold up essentially all of the natural process of geographical changes associated with the rivers in the Study Area. However, such limitation of geomorphological changes is considered to contribute towards the continuous and sustainable livelihood of the general public in the Study Area. It is also considered that no part of the structural measures of the Project should cause any significant adverse effect on the ambient natural environment.

2) Spoil Bank

The area of spoil bank planned to create in the area adjacent to the confluence of the Rio Chico River and Bamban River is 432 ha. This will cause to change water courses of the small streams adjacent to the area. Land ownership should also be checked thoroughly as the area appears to be used for rice field.

(3) Water Quality

The project will not cause any significant changes on the water quality of the surface and ground water. However, construction works of diking and channelization in the Study Area will probably change water quality parameters, especially turbidity, during the construction period, which would normally be conducted in the dry season.

3.2 BIOLOGICAL ENVIRONMENT

(1) Fauna

Slopes of the dike could be planted with trees and bamboo that should help stabilize the dikes. At the same time, these would provide shelter and feeding areas for several wildlife species such as rodents, birds and amphibians.

Locust infestation is a major problem in the lahar affected areas, especially along the dikes and plowed fields with thick lahar and ashfall deposits. Locust would lay their eggs in water-free, soft sandy substratum and the areas with thick lahar deposition in Concepcion, Mabalacat, Bamban and Angeles City shall be the suitable sites for locust breeding. Since sugarcane is their major food source, preventing them from a large scale reproducing is almost impossible. Locust, however, will attract and enhance the population of insect-eating birds, mammals and lizards.

The project shall have minimal disturbance to wildlife within the vicinity of the project site. Sabo dams that shall be constructed at the Sediment Source Zone and Sediment Transition Zone are even beneficial to certain wildlife species as most of the habitats in these areas have been destroyed by the Mt. Pinatubo eruption.

Sabo dams made either of sandbags, rocks or stones inside wire mesh may provide temporary shelter to small species such as ground skinks, snakes, rodents and shrews. They also provide shelter to other invertebrate species like freshwater crabs and shrimps, and the worms that wildlife species feed on.

The sand pocket along Mabalacat and 329 highways at Barangay San Francisco, Concepcion, Tarlac will permanently bury some rice fields and sugarcane fields which are utilized as shelter and habitat to certain wildlife species. However, this habitat loss to wildlife is minimal.

The sand from the lahar that will eventually be deposited in this area will provide some ideal sites for the nesting area of Bee-eater (Merops viridis, M. philippinus), Kingfishers (Halcyon chloris, Ceyx lepidus) and Bank Swallows (Riparia paludicola). Ricefield rats (Rattus mindanensis, R. exulans) can also utilize the sand cliffs for their nesting burrows and tunnels.

The most important environmental impact brought about by this Project is the faster lahar conveyance toward the low-lying areas and natural catch basins such as San Antonio Swamp around the confluence of Rio Chico and Bamban River, Candaba Swamps and many Pampanga River estuaries.

With faster flow of water and lahar during the rainy season along the much improved water channels of Sacobia/Bamban River, Rio Chico river shall be filled up with coarse lahar materials while excessive flood water would carry fine particles of the sand in the river. When the stream reaches to the flat area, it should stay longer in the natural catch basins adjacent to Rio Chico River where much of the lahar has already been deposited. Thereby, the water-borne fine particles in the water should settle in the San Antonio Swamp. The rest of the water-borne fine particles and silt should be carried toward Pampanga river estuaries. As a result, deposition of lahar materials below Rio Chico River is limited i.e. very limited effect is expected to occur to Candaba Swamp.

(2) Flora

1) Revegetation on the Mt. Pinatubo Slopes

Growing vegetation on the steep slopes accumulated with the pyroclastic material is one of the aims of this study. However, this program is considered not effective, or at least necessary to conduct extensive study for the following reasons.

- Depth of the pyroclastic material will affect the efficient plant growth i.e. how deep the original top soil for organic content as soil fertility is important;

- Biological progression of the present grass community may be the fastest and the most inexpensive vegetation growth alternatives for slope stabilization, especially In the view that the planted/sprayed seeds may not take roots before the following rain/typhoon season;

- Tree species are considered inappropriate because of the characteristics of volcanic materials;

- Conducting extensive experimental works should be involved in order to determine the most effective species of grass either by conventional planting or by the modern engineering measures of seed spraying;

- Extensive area may be involved for a costly operation whose cost can be spent for support- ing livelihood programs.

2) Dike Construction Area

Slope protection measures for the dikes already constructed for emergency measures may be more important than the up-stream slope protection measures as dikes made of volcanic materials are vulnerable to heavy rainfalls. Dikes in various locations now show signs of deterioration. Some communities have already planted bamboo at the bottom of dikes in order to stabilize the slope of the dikes as well as for future use of bamboo for commercial purposes. Thus, extensive slope protection program should be established for the following reasons:

- it will activate the participation of the local communities;
- it will increase the opportunities of temporary employment of the local people;
- it will safeguard and strengthen urgently constructed dikes which are not as resilient as the permanently constructed dikes.

3) Natural Growth

In general, pioneer grasses like talahib and legumes should dominate the mudflow deposit areas (see Table P.1.47). These species will be the major species for the next several years to a couple of decades depending on the soil fertility and the level of intensity of man's economic activities conducted in the mudflow deposit area.

No part of the structural measures of the Project should adversely affect the natural vegetation in the Study Area.

3.3 SOCIAL ENVIRONMENT

(1) Changes in Land Use

1) Sacobia/Bamban River Basin

It is obvious that the structural measures of the Project should protect agricultural land and residential areas along Sacobia/Bamban River from further mudflow and flood events in most cases. Thus, agricultural activities or any other economic activities can resume as soon as the permanent structures for the river improvement measures are completed.

On the other hand, however, depending on the way the area damaged by lahar is assessed as the area not suitable for agriculture, agricultural land should be converted to non-agricultural land. In the case of land owner farmer, conversion of the non-agricultural land should require major capital or it should be sold out for industrial use. Tenant farmers may have to find other job if their land was assessed as non-agricultural land and the land owner sold the land.

2) Abacan River

No changes in land use along most part of Abacan River should occur as dikes constructed before Mt. Pinatubo eruption. However, the structural measures for the downstream area of Abacan River should be reviewed as the flood events are getting more frequent comparing to before Mt. Pinatubo eruption. The extent of damage is more wide spread than before.

There is no protection measures in the upstream area of Abacan River. Depending on the way the erosion occurs, part of the settlement in Angeles City, especially southern edge of the Clark Air Force Base, will be severely damaged as well as the settlement of Sapang Bato.

(2) Infrastructure

1) National Highway

Depending on the intensity of mudflow, San Francisco Bridge on the Route 329 should become endangered, or severely damaged with the present structural measures of the Project as mudflow and flood waters; containing the mudflow into relatively narrow course of the river increases velocity of mudflow. Thus, rehabilitation, strengthening, or construction of new San Francisco Bridge should be considered.

2) Rural Roads

The structural measures of the Project would provide the crest of dikes as rural road. Similarly, the access road to the spoil bank would make the remote area accessible with the local means of transportation.

(3) Agricultural Production System

1) Resuming Agricultural Activities without Fear

With the sense of security as they are away from the damaging effects of lahar, farmers should obtain more opportunities to practice farming, including diversifying their agricultural activities. Thus, they will be given more opportunities to generate their income for their families.

The land used for agricultural production and related livelihood activities in the Study Area is generally protected in all municipalities as the structural measures of the Project are implemented. In this respect, farmers can implement their own soil rehabilitation strategies in order to allow normal growth of crops.

2) Availability of Water for Irrigation

Depending on the locations, availability of irrigation water especially in the main course of Sacobia/Bamban and Abacan River will have to be reorganized as diked river banks would limit the farmers access to water for irrigation. Sapang Balen River Improvement Works would divert original course of water way in places and diking would limit the access to the water in the river. Therefore, major reorganization of the way the river is used will have to be considered.

(4) Impacts on the Local Community

1) Land Ownership

Nothing on the land ownership has been discussed openly and thoroughly as no concrete decision has been made on the Project. On the other hand, the structural measures already conducted on site are understood among the local residents that they are of temporary and urgent nature. Thus, no portion of privately owned land has been formally negotiated for purchase, nor paid for the construction of urgent structural measures which has taken place in the Study Area. This is one of the major concerns of the local land owner residents. It is obvious that as soon as the permanent measures of the Project are decided to implement, formal negotiation should begin. In order to clarify the issue, the following is required to conduct for the Feasibility Study:

- Obtaining information on the central government's intention on the land acquisition for the Project;

- Obtaining information on the local government's intention on the land acquisition for the Project;

- The most realistic administrative practice on the land affected by lahar;
- Justification of the legitimacy on the central and the local governments' intention on the land acquisition by competitive lowers and judiciary; and
- The intention of the land owners.

2) Protection of Barangays

The most critical impact given by the structural measures of the Project is protection of the badly devastated areas. Thus, psychologically stabilizing the mind of people in the Study Area is achieved. This will make them come back to their original habitat and resume activities such s to invest in their homes, farms and other properties. This positive impact would last for as long as the control structures serve their purpose.

3) Employment Opportunities During the Construction Works

The constructing works of the river improvement structures would require skilled and unskilled laborers. Recruitment of the local residents from the areas where structures would be built would be relatively easy. This would supplement the deficit of income for those who can not resume agricultural activities in the Study Area.

4) Strengthening the Organization of the Local Communities

Upon completion of the structural measures of the Project, the adjoining communities would be assigned for the task of maintaining and monitoring the conditions of river improvement structures throughout the year. They would thus be given a concrete opportunity to work together with their neighbors for their common goal. This would function to strengthen their cohesiveness among the communities.

(5) Historical Sites

As per the result of the initial archaeological assessment, Barangay Sapang Bato has been the typical early lowland settlement as they displaced the Aeta. The possible archaeological facts might belong to the late 14th century as well as the Aeta artifacts as the area is in their former ancestral land.

Possible archaeological findings of value may be found in Barangay Cacutud. The area is directly affected by dike construction works undertaken by the Project.

The town of Bamban contains historical structures such as the old church, Spanish and American period houses, and the ruins of the Central Azucarera de Bamban which is proximate to the river. Ocular inspection shows patterns of early settlement within the area. Possible archaeological impact must be considered during the construction works of the Project.

The identified Aeta communities within the Bamban ancestral area located in the upper Sacobia River are considered outside the area of structural measures.

The southern portion of Concepcion, Tarlac and surrounding communities particularly the northern portion of Sta. Rita, Barangay Minane and the northern portion of Sitio Macabacle of Barangay San Francisco are replete with historical structures of the late Spanish and early American periods. The impact on these historical structures and resources might occur upon constructing the intervening structures.

Overall assessment of the environmental impacts caused by the Project is shown in the Table P.3.1.

P.4 ENVIRONMENTAL MANAGEMENT PLAN

4.1 INCORPORATION OF EXISTING ECONOMIC DEVELOPMENT PROGRAMS

In the case of evacuation measures, research works for IEE have revealed that almost no measures have been taking positive effects on the livelihood of the local residents. Options available for those in the evacuation centers are:

- to reestablish their livelihood in changing their occupations;
- to return to the original area of residence and resume their own occupations;
- to be allowed to migrate to other areas for permanent resettlement;
- to form evacuation centers as permanent communities for them.

None of these options are considered attractive by the evacuees. Thus, permanent measures of "livelihood recovery program" for protecting, enhancing and developing the interests of the people affected by the Mt. Pinatubo eruption.

The livelihood program should be based on the extensive rural development studies and that it is incorporated with a number of studies associated with Mt. Pinatubo recovery program. One of the alternatives, and most realistic and attractive program, would be to incorporate it with the "Central Luzon Development Program" being conducted by the Department of Trade and Industry in association with JICA assistance.

4.2 AGRICULTURAL ACTIVITIES

(1) Soil Rehabilitation Program

The structural measures of the Project themselves do not cause significant adverse effects on the soils in the Study Area. However, structural measures of the Project is to safeguard majority of agricultural and residential areas in order to make it possible to resume farming, or livelihood in general. Thus, increasing organic content in the lahar affected area is necessary. The physico-chemical properties of the soil in the Study Area are very poor in physical properties for water holding capacity and avail-able nutrients and organic matter for sustaining plant growth.

Thus fertilization and irrigation are necessary for agriculture in the Project Area in order to resume the amount of harvest and income before the Mt. Pinatubo eruption. Organic matter build up specifically on the top soil is indispensable for sustained productivity. This can be achieved through:

- enhancement of vegetation;
- artificial input of organic matter;
- composting; and/or
- a combination of the above

One of the attractive strategies for rehabilitation of the soil in the Study Area is to introduce a large quantity of biodegradable urban waste. The biodegradable urban waste from the town centers and factories as well as the Metro Manila can be hauled to the lahar affected areas. The hauling trucks can then take lahar deposit to serve as construction material in the urban centers. Remains of sugarcane and mudpress from the sugar mills in Central Luzon can also be used.

The dense growth of wild Saccharum and Calopogonium as the pioneer species of grass. The soil already stabilizing in the lahar affected area is indicated by them. Thus, the area covered with them is the area to start with soil rehabilitation program. These plants can also be cut for which the biomass is incorporated into the lahar as organic matter.

(2) Pilot Farming

A lot of agricultural crops suitable to grow in the lahar affected areas could be discovered provided that the proper plant nutrition and moisture is maintained. Spontaneous verification trials have been made in the actual lahar fields within the Study Area. However, this should be given priority with large scale research works based on the scientific and commercial basis and that the associated pilot farming can be implemented. A larger scale of government organization, municipality and up, should be responsible for this scheme.

(3) Irrigation Development

The existing irrigation systems must be reorganized in order to increase cropping intensity. It is particularly important as soil fertility in the Study Area has been drastically changed. It is also necessary as potential changes of the waterway in association with the structural measures of the Project should occur.

4.3 MAINTENANCE WORKS OF THE RIVER IMPROVEMENT STRUCTURES

(1) Preventing Secondary Erosion on the Dikes

Stabilization of the slope of the dikes with vegetation or any artificial means should be considered in order to prevent it from erosion as extensive gully erosion, etc. may cause the dikes to breach. Vetiver grass or moras are promising tall grass species cultivated for erosion control and river embankment stabilization. The species is not rhizome-forming but produces several tillers. It is a good soil binder due to roots penetrating to deeper layers. The bunchy growth habit can grow in association with talahib in drier areas and with Phragmites in wet sites. The species is being cultivated as pilot project of BPI and grown in the research station. The species is cultivated in backyard and gardens for their aromatic roots and source of Vetiver oil. Dried roots are placed in cabinets as insecticide. The species although not grown in commercial scale can be found throughout the country thriving in wet and dry situation. It can grow in all soil types, acidic but not pure sand and alkaline. Vetiveria zizanoides is a promising species particularly on steep slopes and river embankment along Sacobia/ Bamban and Abacan River.

(2) Channelization of Abacan River

Diking at the exit of Abacan River as well as proper channelization of the drainage to the main stream of Pampanga River should be conducted in order to prevent flooding the area in the east of Mexico.

4.4 FOREST REHABILITATION PROGRAM

For the protection of watersheds and for prevention of soil erosion, mountain slopes should be intensively forested. Species native to the Study Area should be selected since these are adapted to the growing conditions of the region. Fast growing tree species should be planted starting in the area where gully erosion is noticeable and moving planting towards the upper slopes of Mt. Pinatubo would be effective. Species such as Macaranga, Mallotus, Endospermum, Omalanthus, Ficus, Broussonetia, Commersonia and Premna are suggested. Collecting the seed of these trees and grow them in nurseries, and planting seedlings at the onset of the rainy season are important.

An alternative is to introduce species not native to the place but have desirable qualification as fast grower, resistant to pests, diseases and other stresses. There are recommended forest species for specific.

Table P.1.48 presents the reforestation species adapted to the study area. There are thirteen (13) species listed, four of these were observed in progress during the visits, these are Yemane (Gmelina), Rain tree (Samanea), Katuray (Sesbania) and Kakawati (Gliricidia).

To restore soil fertility and stability through revegetation, planting leguminous seeds should be done for rapid spread of vegetation. This should be done for the areas covered with less thick lahar deposits. Legumes can tolerate acidic soils and those of marginal in fertility.

P.5 ENVIRONMENTAL MONITORING PLAN

5.1 WATER QUALITY

Monitoring works for water quality should be conducted at least once a year for the next 5 years until such time that there are no further changes on the facility construction works. Monitoring work on the water quality in the study area should be reviewed according to the engineering measures introduced as it changes the present scope of works.

It is also necessary to conduct water quality monitoring during the peak period of construction works, mainly dry season, as turbidity and other parameters related the to water quality of the rivers in the Study Area is disturbed. It is important to note that demand on water goes up toward the end of dry season while dry season is considered best time for construction works.

5.2 SOIL FERTILITY

Soil fertility monitoring should be integrated with which agricultural development program is the major portion of the livelihood program.

5.3 LIVING CONDITIONS OF THE RESETTLEMENT AREAS

Monitoring the living conditions in the resentment centers should be divided into two different phases and areas as follows:

1) Evacuation centers

Establishing livelihood program for the local residents in the Study Area should solve most of the problems associated with the present evacuation centers. However, as the present evacuation centers are going to be the "permanent residential area" for most of the evacuees, selected locations should be up-graded as village, or town. Facilities for the area of population concentration, such as dispensary, market place, primary schools, etc. should be constructed.

Which evacuation centers are of permanent nature has not been considered. Thus, monitoring various evacuation centers and assessment of them. Information should be gathered on the conditions that they should be up-graded to village or town. Such information and the result of assessment should be provided to the government organizations concerned with community development.

2) Permanent resettlement areas.

The present living conditions of the evacuation centers may not be drastically improved. However, the present effort to monitor and up-grade where there is a sign of deteriorating standard should be maintained to give them further hopes to reestablish their original life style in the future.

The standard of life in the permanent resettlement areas and the level of achievement on the development for their livelihood should be monitored until such time that the life of the resettling families are stabilized and that their traditional life style is taking root in each resettlement area.

5.4 *SILTATION IN THE RIVER*

Heavily silted areas as a result of lahar deposit should be constantly monitored. Criteria of the depth of siltation in relation to the possible flooding events and adverse effect to the agricultural activity should be established i.e. "preventive measures" should be established in order to minimize damages to the agricultural areas and the livelihood of the general public. This may be incorporated with the "Early Warning System" being considered to establish within the frame work of the Study. The monitoring work should continue until such time that the Sacobia/Bamban and Abacan River basins are declared as safe for economic activity.

5.5 *MONITORING CANDABA SWAMP*

(1) Aquatic Life

Lahar deposit and sedimentation in San Antonio Swamp and Candaba Swamps must be monitored after the rainy season and continuous sampling of mud and silt deposits in these areas for invertebrate animals as they indicate availability of food for aquatic birds in these areas.

(2) Locust

Locust population should also be monitored as they are part of the food sources of insectivorous birds and mammals. It will also help in monitoring the spread of locust to other areas, as these insects are pest to sugarcane, corn and rice.

(3) Migratory Birds

Migratory bird species using Candaba Swamp and San Antonio Swamp as breeding ground or an intermittent point for resting during the migration along the Pacific Flyway should be conducted. The monitoring should be conducted until such time that the lahar flow and siltation to the water channels are considered permanently ceased.

5.6 *LOCUST POPULATION*

Locust population should be monitored in the lahar affected areas as they are pest to sugarcane, corn and rice.

P.6 FURTHER STUDY

6.1 *FLOOD AREAS ADJACENT TO THE DIKE CONSTRUCTION AREA*

There have been evidences that the localized flood events are increasing in the areas adjacent to the dike construction areas along the Bamban River. The drainage system of these areas used to be directed to the river whereas, after the eruption and the construction of the dikes have blocked the drainage system. As a result, the barangay Balutu has been facing flooding during the rainy season in 1994. Thus, proper drainage system construction/dredging works associated with the sand pocket construction works should be conducted in the area as a matter of urgency.

6.2 *SOIL REHABILITATION MAP*

For the strategic planning for livelihood program, soil rehabilitation map should be made urgently. It is divided into three different categories of :

1) Lahar Affected Areas;
2) Ashfall Areas; and
3) Evacuation/Resettlement Areas

Lahar Affected Areas and Ashfall Affected areas are further sub-divided into several

areas depending on the degree of damage i.e. depth of debris because the thickness of the volcanic materials would be the "key factor" for the vegetation rehabilitation and in turn this is the "key factor" for livelihood program of the area affected by the Mt. Pinatubo eruption as it is directly related to the hopes of the local residents, majority of them are farmers and even the former shop keepers, and the industrial workers used, including those who worked for CAB, are entering to the agricultural sector to help reorganize the local communities. Thus

it is essential to make a map of "soil/vegetation rehabilitation" on which strategic livelihood program would depend.

Land rehabilitation map should be made based on the soil survey of which thickness of volcanic materials, physical classification, chemical characteristics and the overall soil fertility and the suitability to food and commercial crop growing are the criteria. Based on this map, strategic land use planning should be established. Thereby, the evacuees and those affected by the aftermath of the eruption can be reorganized to return to the areas of which their livelihood can be ensured.

6.3 LIVELIHOOD PROGRAM

Since those of affected by lahar have voiced up of their concern on the agricultural development, and those who have not been previously engaged agriculture are willing to enter into agricultural sector, agriculture development program would have to be the top priority option for the livelihood program as described in the next section.

The livelihood program for Aeta should be considered

6.4 INTEGRATED AGRICULTURAL DEVELOPMENT PROGRAM

(1) Irrigation System Development

The program should focus on the irrigation system development on:

- The each river basin area, including those to the north of Sacobia/Bamban River;
- The ground water irrigation system.

The study should focus on the best possible combination of surface water irrigation system and the groundwater irrigation system, cost implications and their feasibility. The changing nature of upper stream catchment area should be taken into consideration of water availability.

(2) Pilot Farming

Because of the permanent changes in the soil characteristics of the study area, alternative cropping items, their biological growth potentials and their marketability should be assessed to the potential crops. Particular attention should be paid to the system of developing integrated organic farming i.e. a combination of maintaining chicken pen, cattle rearing and regular farming technique. Thereby, the organic input to the soil within the unit of farming area, however individual or collective, would be increased without major spending on fertilizers, risking increasing amount of chemical fertilizers.

(3) Mechanization of Farming Technology

Mechanization of farming technology should be considered. The study should focus on the strategic area of mechanization in local agricultural technology in relation to the thickness of lahar/ash deposit since the deep mechanical tillage for optimum mixture of high organic content top soil of the area, now under lahar/ash, is the key element to rapid recovery of soil fertility.

If feasible, establishment of inexpensive farming machinery renting center for the local farming families should be considered as an urgent project in order to increase a number of items of productive and marketable agricultural commodities, while increase in the fertility of the soil and diversification of agricultural technology to avoid mono-cultural tendency rice farming in the study area are achieved. Thereby, in long term, livelihood of the local farmers, especially their extra cash income, will be improved.

TABLES

Table P.1.1 Soil Characteristics of the Study Area

Location	Depth(cm)	pH (1:1)		SO4	Zn	Cu	Fe	Mn	OC	OM	N	Avail.	Milliequivalents/100g of Soil							
													Exchangeable Basis					Exch.	CEC	Base Satutn.
		H2O	KCl	ppm	ppm	ppm	ppm	ppm	%	%	%	ppm	Ca	Mg	Na	K	Sum	Acid	Sum	(%)
Libutad, Mabalacat	0 - 25	5.02	3.88	0.00	0.21	2.29	22.97	29.84	0.31	0.53	0.03	21.93	0.83	0.06	0.06	0.04	0.99	2.97	3.96	25.00
Kisyo, Mabalacat	0 - 15	4.78	4.06	0.70	T	1.68	31.25	4.81	0.41	0.70	0.04	26.09	0.27	0.03	0.06	0.04	0.04	0.99	1.39	28.78
Paralayunan, Mabalacat	45 -100	5.67	4.72	0.00	0.50	3.21	67.70	27.08	0.63	1.08	0.05	13.95	1.73	0.74	0.07	0.03	2.57	7.92	10.49	24.50

Table P.1.2 Summary of Water Quality Standards from Various Sources

Criteria	Philippines (NPCC)			World Health Organization		Australia	
	Surface Water	Ground Water		Surface Water	Ground Water	Surface Water	Ground Water
	Class D*	GA**	GB***			(Fresh Water)	(Domestic Water Supply)
Dissolved Oxygen (DO), ppm	3	-	-	-	-	4 (minimum level)	-
pH	6.0-8.5	6.5-8.5	6.0-8.5	-	6.5-8.5	6.0-9.0	6.5-9.0
Total Dissolved Solids (TDS)	1,000	-	1,000	1,000	1,000	-	1,000
Temperature	increases by 3	-	-	-	-	increase by 2 only	-
Calcium, mg/l	-	75	-	-	-	-	200
Magnesium, mg/l	-	50	-	-	-	-	if 250mg/l sulphate= >30 if <250mg/l sulphate= 150
Chlorides, mg/l	-	200	-	250	250	-	200-600
Hardness, mg/l	-	-	-	500	500	-	500
Coliform	-	50	-	-	0-10	-	0/100ml
HEAVY METALS							
Chromium (Cr), mg/l	0.10	0.05	0.1	-	0.05	0.01	0.05
Iron (Fe), mg/l	5.0	1	5	-	0.3	-	0.3
Copper (Cu), mg/l	0.20	1	0.2	-	1.0	0.05	1.0
Zinc (Zn), mg/l	2.0	5	2	-	5.0	0.005	5.0
Arsenic (As), mg/l	0.10	0.05	0.1	-	0.05	0.01	0.05
Cadmium (Cd), mg/l	0.01	0.01	0.01	-	0.005	30 for hard water 4 for soft water	0.01
Mercury (Hg), mg/l	-	0.002	-	-	0.001	<0.2	0.002
Lead (Pb), mg/l	5.0	0.05	5	-	0.05	0.01	0.05

* Class D = used for irrigation, agriculture
** GA = Domestic water supply
*** GB = for irrigation, agriculture

Note: Sources used are: Philippines = NPCC; World Health Organization = WHO, 1984; Australia = A compilation of Australian Water Quality Criteria.

Table P.1.3 Water Characteristics of the Sapang Bato River

Station	Temperature (oC)	Color	pH	Turbidity	DO (ppm)	Ortho-P (ppm)	Alkalinity (ppm)	Nitrate (ppm)	Ca (ppm)	Mg (ppm)	Total Hardness (mg CaCo3)	Conductivity (u mhos/cm)	Chlorides (ppm)	Soil O.M. (%)	Gross Primary Productivity (gC/M2/day)
1	28	clear	6.3	clear	4.60	1.50	66.00	1.152	9.42	9.03	60	12032.10	16	3.91	0.75
2	28	clear	6.3	clear	5.55	1.70	62.10	1.645	9.61	12.07	174	11922.45	21	0.16	1.35
3	28	clear	6.3	clear	5.65	2.17	67.00	1.810	12.88	6.54	59	12088.61	28	0.73	2.10

Table P.1.4 Chemical Attributes of the Abacan River

Station	Conductivity umhos/cm	pH	Nitrate (ppm)	Ortho-P (ppm)	Mg (ppm)	Ca (ppm)	Alkalinity (ppm CaCo3)	Total Hardness (mg CaCO3)	Total Hardness (mg CaCO3)	Chloride (ppm)	Total Solids (mg/m3)
1	19,635	7.50	1.24	2.66	14.40	12.51	67.0	90.0	31.0	27.0	182.0
2	19,635	7.35	1.24	3.25	6.83	15.23	64.0	66.0	38.0	13.0	160.0
3	19,380	7.45	1.59	3.65	14.02	14.20	66.0	64.0	35.0	20.0	178.0
Average	19.550	7.43	1.36	3.19	11.75	13.98	65.7	73.3	34.7	20.0	173.3

Table P.1.5 Water Quality of three Central Luzon Rivers before the Mt. Pinatubo Eruption.

	pH	DO (ppm)	TDS (mg/l)	Cg (mg/l)	Mg (mg/l)	Hardness (mg/l)	Cl (mg/l)	Date
Sto Niño San. Fernando, Pampanga	7.30	0	-	-	-	160.0	452.00	NWRC, 1983
San Jose, San Fernando, Pampanga	7.30	0.05	-	-	-	250.0	226.00	NWRC, 1983
Rio Chico River, Zaragoza, Nueva Ecija	6.63	-	285.33	75.67	10.25	114.5	33.42	DPWH, 1986 - 87
	7.17	-	196.98	92.50	7.29	122.5	68.19	DPWH, 1989 - 90

Table P.1.6 Heavy Metals in the Water of the Selected Rivers in the Study Area

Location	Cr (mg/l)	Fe (mg/l)	Cu (mg/l)	Zn (mg/l)	As (mg/l)	Cd (mg/l)	Hg (mg/l)	Pb (mg/l)	Examined by
Sto Niño San. Fernando, Pampanga	-	2.3	-	0.16	0	0	0	-	NWRC, 1983
San Jose, San Fernando, Pampanga	-	2.29	-	0.07	0	0	0	-	NWRC, 1983

Table P.1.7 Groundwater in the Study Area

Province	Town/City	Examined No.of wells	Average Well Depth (m)	Average Static Water Level (m bgl)	Average Yield (l/sec)
Pampanga	Angeles	28	82.63	11.00	0.79
	Mabalacat	21	36.19	5.50	0.65
	Magalang	17	46.90	3.53	0.91
	Mexico	36	61.10	2.33	1.00
	Arayat	28	40.38	3.05	0.88
	Candaba	26	52.90	3.15	0.49
Tarlac	Bamban	22	12.90	3.70	0.75
	Concepcion	29	12.30	1.80	1.05

Table P.1.8 Useful Plants for the Life Style of the Aeta (1/3)

(1/3)

Family	Scientific Name	Common Name	Use of the Plant
ACANTHACEAE	Blechnum pyramidatum (Lam.) Urb.	buko- buko	food for the pigs
AMARANTHACEAE	Amaranthus spinosus L.	aya-mantiig	food _ young leaves & shoots
	A. viridis L.	aya-kabayo	food - young leaves & shoots
	Cyathula pfrostrata (L.) Blum.	malakohyawan	midicine
ANACARDIACEAE	Anacardium occidentale L.	maluko	food (inclorescence & fruit)
	Mangifera indica L.	mangga	Food (fruit)
ANNONACEAE	Annona muricata L.	lalbanus	food (fruit)
APIACEAE	Centella asiatica (L.) Urban	talun-bakolane	medicine/coughs and colds
BIXACEAE	Bixa orellanna L.	akwiti	flavoring'medicine
CARICACEAE	Carica papaya L.	papaya	fruit
CHENOPODIACEAE	Chenopodium ambrosioides L.	gudulyo	medicine for malaria
COMPOSITAE	Artemesia vulgaris	kamaria	medicine (fever & cough)
	Ageratum conyzoides L.	kalaotutan	medicine (blood clotting)
	Bides pilosa		medicine (goiter)
	Eclipa albba (L.) Hassk.	buko-buko-lanim	medicine
	Elephantopus spicatus Aubl.	dila-dila-baka	medicine for wounds
	Emilia sonchifolia (L.) Dc.	handuyong-a-lilinaw	medicine for sore eyes
	Tridax procumbens L.	antak-aho	food (vegetable)
CONVOLVULACEAE	Ipomoea batatas (L.) Poir.	kamote	food (shoots & roots)
	I. triloba L.	kakamoti	raw food (shoots & roots)
CUCURBITACEAE	Cucurbita maxma Duch.	kalubaha	food/medicine
	Benincasa hispida (Thunb.) Cogn.	kondol	food (fruits)
	Luffa cylindrica (L.) M.Roen	kabatuti	food (fruits)
EUPHORBIACEAE	Eupborbia hirta L.	hawaan	medicine
	Jatropha curcas L.	takumbaw	hedges (seeds for poison)
	Mlnihot esculenta Crantz	imodos	food (shoots & roots)
	Phyllanlhus simplex Retz.	lihik- lihik	medicine for malaria
	Ricinus communis L.	tangan-tangan	oil for constipation
LABIATAE	Hyptis brebipes Poir.	panti-panti	medicine for headache
(LamiaCEAE)	H. suaveolens Poir.	tumtum	medicine for fever and cough
LAURACEAE	Persea americana Mill	abokado	food
LYTHRACEAE	Lagerstroemia speciosa	banaba	medicine
MALVACEAE	Hibiscus rosa - sinensis L.	gomamila	medicine/ornament

Table P.1.8 Useful Plants for the Life Style of the Aeta (2/3)

(2/3)

Family	Scientific Name	Common Name	Use of the Plant
	Urena lobota L.	kolot-dam-wag	bark for cordage
	Abelmoschus moschatus Medic	tagatuhi	necklace to frighten spirits
	Sida acuta Burm. F.	Lingi	
MELIACEAE	Sandoricom koetjape (Burm.f.) Merr.	Katoh	medicine
MENISPERMACEAE	Anamirta cocculus (L.) W. and A.	labtang	powdered seeds edible
MORACEAE	Artocarpus altilis (Parkins) Fosb.	runas	food (fruit)
	A. heterophylla Lam.	yanka	food (fruit)
MYRISTICACEAE	Myristica philippensis Lam.	tambalaw	coloring
MYRTACEAE	Psidium guajava L.	bayabas	food & medinice
OLEACEAE	Linociera ramiflora (Roxb.) WWall.	palikayuwun	for bows
OXALIDACEAE	Averrhoa carambola L.	balimbing	food
	A.bilimbi L.	pias	food and medicine
PASSIFLORACEAE	Passiflora foetida L.	olmot-olmot	food
PIPERACEAE	Piper betel L.	hanat-mantung	medicine
SCROPHULARIACEAE	Scoparia dulcis L.	magugudulyo	medicine
SOLANACEAE	Solanum nigrurm L.	unitih	medicine
	Nicotiana tabacum L.	tabako	medicine & cigarette
	Solanum melongena L.	talon	food
	Capsicum anuum L.	lada-baali	food/seasoning
	C. frutescens L.	lada-balang	food & medicine
	Lycopersicon esculentum Mill.	kamatih	food
TILIACEAE	Corchorus olitorius	pasao	food
	Triumfetta bartramia L.	kolot- mantug	medicine
	Muntingia colabura	datalis	food & medicine
VERBCNACEAE	Allicarpa formosana Rolfe	apyoh	pounded leaves for poison
	Premna odorata	alagaw	medicine
	Vitex negundo	lagundi	medicine
ARACEAE	Colocasia esculentum (L.) schoot	tau	food
BROMELIANEAE	ANANAS COMOSUS (L.) MERR.	pinya	food & medicine
DIOSCOREACEAE	DIOSCOREA ESCULENTA (LOUR.) BU	buwugan	food
	D. ALATA L.	ubi	food
	D. BULBIFERA L.	bakyot	food
	D. CUMINGII PRAIN AND BURKILL	lubi-lubi	food

Table P.1.8 Useful Plants for the Life Style of the Aeta (3/3)

(3/3)

Family	Scientific Name	Common Name	Use of the Plant
GRAMINEAE	Bambusa Vulgaris Schrad.	kawayang-kiling	bows
	Coix lachryma - jobi L.	bantakan	medicine & necklace
	Cymbopogon citratus DC.	bangyad	food flavoring
	Eleusine indica (L.) Gaertn.	hayapuh	medicine
	Oryza sativa L.	poli	food
	Paspalum conjugatum Berg.	kalumpay	foriage
	Zea mays L.	mais	food
IRIDACEAE	Eleutherine palmifolia (L.) Merr.	Ikasona-song-song	medicine
MARANTACEAE	Maranta arundinacea L.	sago	food
MUSACEAE	Musa paradisiaca L.	haa	food
	M. sapientum L.	haa	food
PALMAE	Areca catechu L.	bunga	chewing gum
	Arenga pinnata (Wurvmb.) Merr	iduk	bows
	Caryota cumingii Lodd.	takipan	bows (substitute)
	Orania palindan (Blco.) Merr.	banga	bows
CAESALPINIACEAE	Bauhinia malabarica Roxb.	alibangbang	food
	Senna alata (L.) Roxb.	buka- buka	medicine for skin disease
	Tamarindus indica L.	sampalok	medicine & seasoning
MIMOSACEAE	Albizia precera (Roxb.) Benth.	karail	food (bark)
	Pithecelobium dulce (Roxb.) Merr.	kamatsile	food & fish poison
	Samanea saman (Jacq.) Merr.	akasya	medicine
	Mimosa pudica L.	dudungoy	medicine
PAPILIONACEAE	Crotalaria ferruginea Grah.	lilinaw-lawak	medicine for eyes
	Crotalaria linifolia L.	lihik-lihik	medicine for malaria
	C. albida Heyne	lihik- lihik	medicine for malaria
	C. acicularis Ham.	lihik- lihik	medicine for malaria
	Derris elliptica (Roxb.) Behth	bunat	roots for fish poison
	Desmodium puchelm (L.) Benth.	kopit-kopit	medicine
	Desmodium trifolium (L.) Dc.	hikhik lowak	medicine
	elincidia sepium (Jacq) Steud.	madri-kawaw	medicine
	Pachyrrhizus erosus (L.) Urb.	kamah-balang	food
	Parosela glandulosa (Blco.) Merr.	dikot-ni-tali	medicine for malaria

Table P.1.9 Summary of Demographic Information in Pampanga & Tarlac (1990)

	Province		City/Town				
	Pampanga	Tarlac	Angeles	Mabalacat	Mexico	Bamban	Concepcion
1. Population							
1990	1,530,696	859,222	236,685	121,115	69,441	35,639	97,776
1993	1,657,979		253,299	136,668	73,040	41,091	115,138
2. Growth Rate							
1980-1990	2.63	2.24	2.28	4.11	2.64	3.18	2.49
3. Density/sq.km	610.3	281.4	3,807.1	638.4	701.6	91.6	608.1
4. Distribution							
Urban	843,743	256,594	229,026	98,250	18,176	23,240	11,482
Rural	450,267	602,628	7,659	22,865	51,265	12,399	86,294
5. Proportion							
Urban	65.20	29.26	96.76	81.12	26.17	65.21	11.74
Rural	34.80	70.14	3.24	18.88	73.83	34.79	88.26
6. Sex Ratio							
Male	434,742	657,735	116,101	60,958	41,064	*15,887	***58,080
Female	424,480	637,102	119,962	60,156	39,942	*15,659	***57,058
Ratio	102	103	97	101	103	*101.5	***101.79
7. No. of Households	159,344	268,547	40,687	22,750	11,234	**4,114	***18,536
8. Average H/H Size	5.39	5.71	5.08	5.32	4.56	**6.34	***5.55
9. Dependency Ratio							
Youth		71					
Old		65					
10. Literacy Rate							
Literate	826,829	1,497,365	174,204	88,717		**15,737	
Illiterate	32,393	35,250	2,313	1,193		**1,918	
Rate	96.23	97.70	98.69	98.67		**89.14	

Note * 1987
** 1980
*** 1993

Sources: 1) Census of Population and Housing, NSO, 1990
2) Socio-ecomic Profile, Pampanga, Angeles City, Mexico, Mabalacat, Bamban and Concepcion

Table P.1.10 Urban & Rural Population Distribution by Municipality, Pampanga, 1970, 1980 & 1990.

City/ Municipality	1970				1980				1990			
	Urban	%	Rural	%	Urban	%	Rural	%	Urban	%	Rural	%
Angeles	-	-	-	-	-	-	-	-	227,466	96.36	8,596	3.64
Apalit	3,459	9.57	32,679	90.43	15,813	32.77	32,440	67.23	62,373	100.00	-	-
Arayat	2,347	5.12	43,493	94.88	10,682	18.83	46,060	81.17	15,691	21.50	57,303	78.50
Bacolor	1,408	3.50	38,804	96.50	6,492	12.74	44,450	87.26	49,560	73.72	17,668	26.28
Candaba	544	1.31	40,968	98.69	9,122	17.23	43,823	82.77	23,072	33.86	45,063	66.14
Floridablanca	3,615	9.08	36,215	90.92	8,749	16.94	42,899	83.06	9,707	14.69	56,363	85.31
Guagua	4,898	8.41	53,372	91.59	72,609	100.00	-	-	88,242	100.00	-	-
Lubao	8,168	13.26	53,440	86.74	19,017	24.54	58,485	75.46	99,612	63.89	56,303	36.11
Mabalacat	14,811	26.51	41,068	73.49	54,988	67.91	25,978	32.09	121,114	91.94	10,614	8.06
Macabebe	1,054	2.70	37,963	97.30	45,830	100.00	0	0.00	55,486	100.00	-	-
Magalang	1,097	4.16	25,245	95.84	10,541	30.26	24,299	69.74	18,965	43.32	24,818	56.68
Masantol	9,427	30.87	21,111	69.13	12,809	36.23	22,541	63.77	12,486	29.76	29,471	70.24
Mexico	2,250	5.47	38,895	94.53	6,411	12.01	46,980	87.99	33,626	48.38	35,873	51.62
Minalin	4,885	22.31	17,011	77.69	9,131	33.36	18,238	66.64	34,794	100.00	-	-
Porac	1,168	3.22	35,064	96.78	4,278	8.40	46,628	91.60	68,114	63.38	39,358	36.62
San Fernando	84,362	100.00	-	-	110,891	100.00	-	-	156,891	100.00	-	-
San Luis	2,768	13.70	17,437	86.30	2,939	11.44	22,762	88.56	31,895	70.18	13,553	29.82
San Simon	-	-	19,147	100.00	-	-	23,518	100.00	30,637	57.20	22,928	42.80
Sta. Ana	2,402	12.38	17,000	87.62	2,632	10.38	22,729	89.62	32,519	66.63	16,285	33.37
Sta. Rita	2,089	10.75	17,350	89.25	3,538	14.15	21,457	85.85	28,260	81.88	6,252	18.12
Sto. Tomas	2,167	11.46	16,740	88.54	24,951	100.00	-	-	33,267	100.00	-	-
Sasmuan	-	-	16,792	100.00	2,635	14.72	15,266	85.28	21,140	53.44	18,415	46.56
Pampanga	152,919	19.79	619,794	80.21	434,058	43.73	558,553	56.27	1,254,917	73.23	458,863	26.77

Source: Socio-economic Profile, Province of Pampanga, 1993

Table P.1.11 Population Distribution and Ratio by Sex-Age Groups in Pampanga, 1970, 1980 & 1990

Age Group	Population Distribution of Sex						Sex Ratio (%)		
	1990		1980		1970		1990	1980	1970
	Male	Female	Male	Female	Male	Female			
0 - 4	88,712	82,576	81,935	75,901	66,571	63,950	107.43	107.95	104.10
5 - 9	84,596	79,312	74,736	68,735	63,294	60,572	106.66	108.73	104.49
10 - 14	83,250	78,792	68,861	64,942	54,949	53,012	105.66	106.03	103.65
15 - 20	76,144	71,969	55,482	54,462	43,168	43,236	105.80	101.87	99.84
21 - 24	69,341	65,796	45,213	45,693	34,920	34,821	105.39	98.95	100.28
25 - 29	55,210	52,707	36,186	36,561	23,248	23,867	104.75	98.97	97.41
30 - 34	45,321	44,005	31,836	31,041	19,630	20,856	102.99	102.56	94.12
35 - 39	36,850	35,919	22,949	22,447	18,116	18,732	102.59	102.24	96.71
40 - 44	30,973	30,473	19,716	19,819	13,969	14,968	101.64	99.48	93.33
45 - 49	22,319	22,068	16,424	17,178	11,669	13,286	101.14	95.61	87.83
50 - 54	19,268	19,747	13,044	13,872	9,438	10,665	97.57	94.03	88.50
55 - 59	14,914	15,738	9,992	11,849	8,490	9,263	94.76	84.33	91.65
60 - 64	10,878	11,707	8,003	9,385	6,365	6,843	92.92	85.27	93.01
> 65	19,959	26,293	16,631	19,863	11,115	13,576	75.91	83.73	81.87
unknown	0	0	0	0	57	84			67.86
TOTAL	657,735	637,102	501,008	491,748	384,999	387,731	103.24	101.88	99.30

Source: Socio-economic Profile, Province of Pampanga, 1993

Table P.1.12 Number of Household by Municipality in Pampanga, 1990

City/Municipality	Population 1990	No. of Household	Average Size
Angeles	236,686	46,421	5.10
Apalit	62,373	10,853	5.75
Arayat	73,189	12,100	6.05
Bacolor	67,259	11,470	5.86
Candaba	68,145	11,200	6.08
Floridablanca	66,146	11,543	5.73
Guagua	88,290	15,228	5.80
Lubao	99,705	16,986	5.87
Mabalacat	121,115	22,750	5.32
Macabebe	55,505	9,275	5.98
Magalang	43,940	7,389	5.95
Masantol	41,964	7,042	5.96
Mexico	69,546	11,234	6.19
Minalin	34,795	5,639	6.17
Porac	68,215	11,595	5.88
San Fernando	157,851	27,919	5.65
San Luis	31,920	5,200	6.14
San Simon	30,678	5,154	5.95
Sta. Ana	32,540	5,250	6.20
Sta. Rita	28,296	4,774	5.93
Sto Tomas	33,309	6,039	5.52
Sasmuan	21,148	3,486	6.07
Pampanga	1,532,615	268,547	5.71

Source: Socio-economic Profile, Province of Pampanga, 1993

Table P.1.13 Health Indicators, Leading Causes of Morbidity, Mortality, and Infant, Mortality in Pampanga, 1989-1993

a. Health Indicator

Parameters	1980		1990		1991		1992		1993	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Live Births (CBR)	34,639	28.00	36,035	27.80	37,931	28.52	38,633	28.31	37,393	26.71
Fatal Deaths (CDR)	40	1.14	55	1.53	49	1.29	40	1.03	38	1.01
Infant Deaths (IMR)	309	8.84	481	13.35	453	11.94	352	9.11	343	9.17
Neo-Natal Deaths	57	1.63	59	1.64	48	1.26	70	1.81	35	0.93
Maternal Deaths (MMR)	3	0.09	4	0.11	2	0.05	6	0.15	6	0.16
Death All Ages	4,306	3.45	4,501	3.47	4,394	3.22	4,309	3.15	4,114	2.94

b. Causes of Morbidity

Morbidity Causes	5 year average (1988-1992)		1993	
	No.	Rate	No.	Rate
Acute Respiratory Infection	140,902	10.91	216,129	15.44
Nutrition & Vitamin Deficiency	31,475	2.46	35,373	2.52
Skin Problems	20,546	1.59	33,798	2.42
Intestinal Parasites	24,302	1.88	30,918	2.21
Diarrheal Diseases	29,936	2.32	26,699	1.91
Anemia	24,174	1.87	22,537	1.61
Influenza	17,435	1.35	19,829	1.42
Injuries	8,640	0.45	14,618	1.04
Musketal Diseases	7,672	0.59	14,375	1.3
Brochitis	14,699	1.74	11,039	0.79

c. Causes of Mortality

	5 year average (1988-1992)		1993	
	No.	Rate	No.	Rate
Cardiovascular Disease	751	58.16	782	55.86
Cancer (all form)	416	32.22	405	28.93
Pneumonia	363	28.11	326	23.29
Tuberculosis (all forms)	362	28.04	325	23.21
Diabetis	82	6.35	82	5.85
Kidney Disease	70	5.42	75	5.35
Accidents (all forms)	122	9.45	72	5.14
Liver Disease	57	4.41	51	5.64
Congenital Disease	25	1.93	20	1.42
Diarrheal Disease	41	3.17	12	0.85

c. Causes of Infant Mortality

Infant Mortility Causes	5 Year Average (1988-1992)		1993	
	No.	Rate	No.	Rate
Bronchopneumonia	58	1.55	53	1.42
Prematurity	64	1.71	33	0.88
Septicemia	28	0.75	27	0.72
Congenital Anomaly	26	0.69	25	0.66
Acute Respiratory	18	0.48	15	0.41
Asphyria Neonatorum	11	0.29	12	0.32
Meningo Encephalitis	8	0.21	9	0.24
Nutritional Deficiencies	14	0.37	8	0.21
Accident (all forms)	9	0.24	7	0.18
Diarrheal Disease	12	0.32	6	0.16

Source: 1) Field Health Service Informative System (FHSIS)
2) Socio-economic Profile, Province of Pampanga. 1993.

Table P.1.14 Population Growth Rate and Density by Municipality, Tarlac, 1970, 1980 & 1990

City/ Municipality	Population			Growth Rate (%) 1970-80	Growth Rate (%) 1980-90	Land Area (sq. km.)	Density (p./sq.km)		
	1970	1980	1990				1970	1980	1990
Anao	6,672	6,519	7,955	-0.23	2.01	23.9	279.16	272.76	332.85
Bamban	18,474	26,072	35,630	3.51	3.17	133.1	138.80	195.88	267.69
Camiling	49,156	53,860	62,619	0.92	1.52	140.5	349.86	383.35	445.69
Capas	35,515	46,523	61,185	2.47	2.78	440	80.72	105.73	139.06
Concepcion	62,227	80,647	103,136	2.63	2.49	245.7	253.26	328.23	419.76
Gerona	41,831	50,433	59,486	1.89	1.66	141.4	295.83	356.67	420.69
La Paz	27,150	35,330	41,938	2.67	1.73	114.3	237.53	309.10	366.91
Mayantoc	13,558	17,135	21,170	2.37	2.14	354.6	38.23	48.32	59.70
Moncada	29,195	34,451	41,672	1.67	1.92	85.7	340.67	402.00	486.25
Paniqui	47,718	55,006	64,949	1.43	1.68	105.2	453.59	522.87	617.39
Pura	12,763	14,801	18,030	1.49	1.99	31	411.71	477.45	581.61
Ramos	9,649	11,215	13,566	1.52	1.92	24.4	395.45	459.63	555.98
San Clemente	6,073	7,117	8,869	1.6	2.23	48.6	124.96	146.44	182.49
San Jose	-	-	20,483	-	-	-	-	-	-
San Manuel	10,683	13,491	17,261	2.36	2.49	42.1	253.75	320.45	410.00
Santa Ignacia	20,775	25,224	30,460	1.96	1.9	75.4	275.53	334.54	403.98
Tarlac	135,128	175,691	208,458	2.66	1.72	936	144.37	187.70	222.71
Victoria	33,141	34,942	42,355	0.53	1.94	111.5	297.23	313.38	379.87
Tarlac	559,708	688,457	859,222	2.09	2.24	3,053	183.31	225.47	281.40

Sources: Census of Population and Housing, NCSO, 1970, 1980, 1990

Table P.1.15 Urban and Rural Distribution by Municipality, Tarlac, 1970, 1980 & 1990

City/ Municipality	1970				1980				1990			
	Urban	%	Rural	%	Urban	%	Rural	%	Urban	%	Rural	%
Anao	-	-	6,672	100.0	-	-	6,519	100.0	354	4.5	7,601	95.5
Bamban	3,529	19.1	14,945	80.9	8,134	35.1	17,938	68.8	20,620	57.9	15,010	42.1
Camiling	12,405	25.2	36,751	74.8	12,221	22.2	41,639	77.3	19,672	31.4	42,947	68.6
Capas	680	1.9	34,835	98.1	2,178	4.6	44,345	95.3	16,238	26.5	44,947	73.5
Concepcion	9,002	14.5	53,225	85.5	10,333	10.5	70,314	87.2	14,683	14.2	88,453	85.8
Gerona	4,090	9.8	37,741	90.2	4,954	10.8	45,479	90.2	18,431	31.0	41,055	69.0
La Paz	859	3.2	26,291	96.8	6,956	17.1	28,374	80.3	8,191	19.5	33,747	80.5
Mayantoc	-	-	13,558	100.0	4,126	20.1	13,009	75.9	4,801	22.7	16,369	77.3
Moncada	4,624	15.8	24,571	84.2	4,596	12.3	29,855	86.7	8,792	21.1	32,880	78.9
Panique	12,957	27.2	34,761	72.8	13,534	21.8	41,472	75.4	16,346	25.2	48,603	74.8
Pura	2,701	21.2	10,062	78.8	2,787	21.5	12,014	81.2	7,862	43.6	10,168	56.4
Ramos	2,971	30.8	6,678	69.2	3,421	26.4	7,794	69.5	4,015	29.6	9,551	70.4
San Clemente	2,105	34.7	3,968	65.3	2,086	24.7	5,031	70.7	2,509	28.3	6,360	71.7
San Jose	-	-	-	-	-	-	-	-	5,100	24.9	15,383	75.1
San Manuel	-	-	10,683	100.0	-	-	13,491	100.0	4,433	25.7	12,828	74.3
Sta. Ignacia	3,572	17.2	17,203	82.8	4,305	20.0	20,919	82.9	13,209	43.4	17,251	56.6
Tarlac	26,519	19.6	108,609	80.4	38,205	22.7	137,486	78.3	78,595	37.7	129,863	62.3
Victoria	7,650	23.1	25,491	76.9	6,897	18.9	28,045	80.3	12,743	30.1	29,612	69.9
Total	93,664	16.7	466,044	83.3	124,733	17.1	563,724	81.9	256,594	29.9	602,628	70.1

Sources: Census of Population and Housing, 1970, 1980, 1990

Table P.1.16 Population Distribution and Ratio by Sex-Age Groups, Tarlac, 1970, 1980 & 1990

Age Group	Population Distribution						Sex Ratio		
	1990		1980		1970				
	Male	Female	Male	Female	Male	Female	1990	1980	1970
0 - 4	58,519	55,104	54,790	51,474	46,042	44,249	106.2	106.4	104.1
5 - 9	56,451	53,826	50,773	47,169	45,792	43,767	104.9	107.6	104.6
10 - 14	53,821	51,574	46,010	44,051	39,869	38,234	104.4	104.4	104.3
15 - 20	49,466	46,942	37,540	36,293	31,061	30,905	105.4	103.4	100.5
21 - 24	42,922	40,603	30,652	31,318	24,372	24,594	105.7	97.9	99.1
25 - 29	34,853	33,498	25,563	26,664	17,402	18,023	104.0	95.9	96.6
30 - 34	29,748	28,736	22,599	21,928	14,501	15,377	103.5	103.1	94.3
35 - 39	24,733	24,147	16,550	16,132	13,548	13,922	102.4	102.6	97.3
40 - 44	20,976	20,853	14,449	14,788	10,293	11,188	100.6	97.7	92.0
45 - 49	15,602	15,780	11,071	11,957	9,303	10,467	98.9	92.6	88.9
50 - 54	13,851	14,106	9,807	9,748	7,702	8,419	98.2	100.6	91.5
55 - 59	10,327	11,179	7,603	9,141	6,381	6,752	92.4	83.2	94.5
60 - 64	7,767	8,691	6,362	7,118	4,847	4,950	89.4	89.4	97.9
> 65	15,706	19,441	12,798	14,109	8,262	9,180	80.8	90.7	90.0
unknown					151	155			97.4
Total	434,742	424,480	346,567	341,890	279,526	280,182	102.4	101.4	99.8

Sources: Census of Population and Housing, 1970, 1980, 1990

Table P.1.17 Leading Causes of Morbidity and Mortality inTarlac

	Number of Cases	Rate in Tarlac	Rate in the Philippnes
Causes of Morbidity			
ARI	199,503	17,589	*
Gastro-Intestinal Disorders	29,566	4,351	*
Parasitism	22,201	3,268	*
Anemia	19,498	2,870	*
Nutritional/Vitamin Deficiency	16,204	2,385	*
Skin	14,643	2,155	*
Influenza	13,747	2,023	370.39
Bronchitis	12,024	1,769	973.27
Injuries	7,027	1,034	*
Musculo-Skeletal Disorders	323	770	*
Causes of Mortality			
Cardio Vascular Disease	474	69	62.13
Pneumonia	447	65	39.60
PTB	210	32	25.20
Cancer	187	27	32.00
Other Heart Disease	175	25	*
Hypertension	140	20	22.41
Accidents	79	11	12.01
Septicema	66	9	4.13
Kidney	51	7	5.20
Asphyxia Neonatorum	40	6	*

* Not included in the 10 leading causes
Rate = No. of Cases per 100,000 Population
Source: PHO Health Profile

Table P.1.18 Production of Rice Before and After Pinatubo Eruption

	1989	1990	1991	1992
1. Volume (in MT)				
a. Philippines	9,458,800	9,319,300	9,673,262	9,128,940
b. Region III	1,684,950	1,910,930	1,747,589	1,815,936
c. Pampanga	192,530	202,758	167,449	165,113
d. Tarlac	256,116	272,178	248,662	300,533
2. Harvested Area (in ha)				
a. Philippines	3,497,300	3,318,700	4,040,850	2,582,180
b. Region III	517,390	529,370	499,870	471,590
c. Pampanga	53,860	51,590	42,800	38,730
d. Tarlac	99,720	105,100	97,990	92,720
3. Productivity (in MT/ha)				
a. Philippines	2.70	2.81	2.39	3.54
b. Region III	3.26	3.61	3.50	3.85
c. Pampanga	3.57	3.93	3.91	4.26
d. Tarlac	2.57	2.59	2.54	3.24

Source: 1) Bureau of Agricultural Statistics, Department of Agriculture
2) Interim Report I of Master Plan Study for West Central Luzon Development Program
3) Interim Report 1: The Study on Flood and Mudflow Control for Sacobia-Bamban / Abacan River Draining from Mt. Pinatubo

Table P.1.19 Growth Rate and Population Density by Barangay Mabalacat, 1980 & 1990

Barangay	Population		Growth Rate (%) 1980-90	Land Area (sq.km)	Density (per sq. km.)	
	1980	1990			1980	1990
Poblacion	2,256	2,552	0.10	0.25	9,024.0	10,208.0
Atlu-bola	354	549	4.49	0.68	520.6	807.4
Bical	840	1,281	4.31	4.63	181.4	276.7
Bundagul	457	987	8.00	2.67	171.2	369.7
Cacutud	1,118	1,563	3.41	1.16	963.8	1,347.4
Calumpang	251	431	5.56	36.57	6.9	11.8
Camatchiles	785	2,916	14.02	0.06	13,083.3	48,600.0
Dapdap	425	572	3.02	4.51	94.2	126.8
Dau	33,152	47,180	3.59	11.47	2,890.3	4,113.3
Duquit	1,231	4,080	12.73	53.51	23.0	76.2
Mabiga	3,708	10,985	11.47	7.36	503.8	1,492.5
Macapagal Village	808	1,215	4.16	6.16	131.2	197.2
Mamatitang	1,445	1,662	1.41	7.17	201.5	231.8
Mangalit	530	649	2.05	1.97	269.0	329.4
Marcos Village	1,199	2,031	5.41	5.37	223.3	378.2
Mawaque	431	549	2.45	4.21	102.4	130.4
Paralayun	512	676	2.82	3.19	160.5	211.9
San Francisco	8,596	10,432	1.95	1.30	6,612.3	8,024.6
Sta. Ines	3,263	4,479	3.22	0.92	3,546.7	4,868.5
Sta. Maria	372	520	3.41	3.51	106.0	148.1
Sto. Rosario	2,015	2,268	1.19	0.77	2,616.9	2,945.5
Sapang Balen	263	347	2.81	4.91	53.6	70.7
Sapang Biabas	300	570	6.63	4.15	72.3	137.3
Tabun	2,217	3,001	3.07	3.81	581.9	787.7
Dolores	7,029	8,218	2.43	14.48	485.4	567.5
San Joaquin	4,248	4,879	1.39	4.60	923.5	1,060.7
Lakandula	3,454	6,524	6.57	0.31	11,141.9	21,045.2
TOTAL	81,259	121,116	4.11	189.70	428.4	638.5

Source: Interim Report 1: The Study on Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, June, 1994

Table P.1.20 Urban and Rural Distribution, Mabalacat, 1980 & 1990

Barangay	Population		Proportion	
	1980	1990	1980	1990
Urban				
Poblacion	2,526	2,552	3.12	2.11
Dau	33,152	47,180	40.95	38.95
Dolores	7,029	8,218	8.68	6.79
Lakandula	3,454	6,524	4.27	5.39
Mabiga	3,708	10,985	4.58	9.07
San Francisco	8,596	10,432	10.62	8.61
San Joaquin	4,248	4,879	5.25	4.03
Sta. Ines	3,263	4,479	4.03	3.70
Tabun	2,217	3,001	2.74	2.48
Sub-Total	68,193	98,250	84.24	81.13
Rural				
Atlu-bola	354	549	0.44	0.45
Bical	840	1,281	1.04	1.06
Bundagul	457	987	0.56	0.81
Cacutud	1,118	1,563	1.38	1.29
Calumpang	251	431	0.31	0.36
Camatchiles	785	2,916	0.97	2.41
Dapdap	425	572	0.52	0.47
Duquit	1,231	4,080	1.52	3.37
Macapagal Village	808	1,215	1.00	1.00
Mamatitang	1,445	1,662	1.78	1.37
Mangalit	530	649	0.65	0.54
Marcos Village	1,199	2,031	1.48	1.68
Mawaque	431	549	0.53	0.45
Paralayunan	512	676	0.63	0.56
Sta. Maria	372	520	0.46	0.43
Sto. Rosario	2,015	2,268	2.49	1.87
Sapang Balen	263	347	0.32	0.29
Sapang Biabas	300	570	0.37	0.47
Sub-Total	13,336	22,866	16.45	18.88
Total	81,529	121,116	100.69	100.01

Source: Interim Report: The Study on Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, June, 1994

Table P.1.21 Population Distribution and Sex Ratio & Age Groups Mabalacat 1990

Age Group	1990 Population		Sex Ratio
	Male	Female	(%)
< 1	1,948	1,740	111.95
1 - 4	6,656	6,236	106.74
5 - 9	7,496	7,128	105.16
10 - 14	7,291	6,872	106.10
15 - 19	6,684	6,714	99.55
20 - 24	6,633	6,853	96.79
25 - 29	5,544	5,564	99.64
30 - 34	4,627	4,612	100.33
35 - 39	3,699	3,579	103.35
40 - 44	3,133	3,132	100.03
45 - 49	2,034	2,031	100.15
50 - 54	1,766	1,705	103.58
55 - 59	1,187	1,305	90.96
60 - 64	907	933	97.21
65 - 69	573	696	82.33
70 - 74	383	473	80.97
75 - 79	223	314	71.02
> 80	174	269	64.68
Total	60,958	60,156	101.33

Source: Socio-economic Profile, Municipality of Mabalacat, 1990

Table P.1.22 Distribution of Employed Persons, Mabalacat, 1990

Occupation	Percentage
Farmers	24.49%
Production and related workers, transport equipment operators and laborers	36.36%
Service Workers	11.90%
Sales Workers	10.40%
Professional, technical and related workers	6.49%
Workers not classified by occupation	5.18%
Clerical and related workers	6.49%
Administrative, executive and managerial work	0.63%

Source: Socio-economic Profile, Municipality of Mabalacat, 1990

Table P.1.23 Population Growth Rate and Density by Barangay, Mexico, 1980, 1990 & 1993

Barangay	Population			Growth Rate (1980-90)	Land Area (sq.km)	Density	
	1980	1990	*1993			1980	1990
Acli	850	979	1,031	1.42	3.25	261.54	301.23
Anao	2,338	2,962	3,108	2.39	1.08	2,164.81	2,742.59
Balas	1,170	1,664	1,765	3.58	2.05	570.73	811.71
Buenavista	559	753	796	3.02	3.96	141.16	190.15
Camuning	1,270	1,574	1,648	3.17	1.84	690.22	855.43
Cawayan	568	638	686	1.17	3.19	178.06	200.00
Concepcion	1,063	1,418	1,457	2.92	0.67	1,586.57	2,116.42
Culubasa	1,716	2,303	2,140	2.99	1.57	1,092.99	1,466.88
Divisoria	758	1,083	1,136	3.63	2.20	344.55	492.27
Dolores	738	1,057	1,261	3.66	2.68	275.37	394.40
Eden	347	362	403	0.42	2.23	155.61	162.33
Gandus	352	473	499	3.00	3.24	108.64	145.99
Lagundi	1,827	2,399	2,652	2.76	2.65	689.43	905.28
Laput	953	1,451	1,502	4.29	1.18	807.63	1,229.66
Laug	1,520	1,847	1,952	1.97	1.59	955.97	1,161.64
Masamat	568	728	778	2.51	2.58	220.16	282.17
Masangsan	1,725	2,147	2,285	2.21	2.76	625.00	777.90
Nueva Victoria	509	641	698	2.33	4.91	103.67	130.55
Pandacaqui	1,033	1,286	1,350	2.21	5.30	194.91	242.64
Pangatlan	1,085	1,352	1,402	2.22	5.91	183.59	228.76
Panipuan	544	726	748	2.93	3.43	158.60	211.66
Parian	3,448	4,109	4,298	1.77	0.39	8,841.03	10,535.90
Sabanilla	922	1,098	1,150	1.76	1.23	749.59	892.68
San Antonio	3,063	3,916	4,138	2.49	0.28	10,939.29	13,985.71
San Carlos	1,520	2,118	2,218	3.37	0.84	1,809.52	2,521.43
San Jose Malino	2,694	3,522	3,619	2.72	2.40	1,122.50	1,467.50
San Jose Matulid	1,410	1,958	2,242	3.34	2.22	635.14	881.98
San Juan	1,795	2,464	2,581	3.22	1.01	1,777.23	2,439.60
San Lorenzo	1,366	1,693	1,736	2.17	0.83	1,645.78	2,039.76
San Miguel	790	1,147	1,199	3.80	1.79	441.34	640.78
San Nicolas	1,174	1,465	1,540	2.24	1.13	1,038.94	1,296.46
San Pablo	1,071	1,335	1,398	2.23	1.04	1,029.81	1,283.65
San Patricio	2,183	2,896	2,929	2.87	2.31	945.02	1,253.68
San Rafael	405	635	669	4.60	2.00	202.50	317.50
San Roque	433	647	698	4.10	1.54	281.17	420.13
San Vicente	1,866	2,429	2,551	2.67	2.20	848.18	1,104.09
Sapang Maisac	1,712	2,387	2,596	3.38	4.03	424.81	592.31
Sta. Cruz	1,060	1,406	1,476	2.87	3.22	329.19	436.65
Sta. Maria	1,148	1,597	1,678	3.36	1.74	659.77	917.82
Sto. Domingo	1,261	1,617	1,689	2.52	1.85	681.62	874.05
Sto. Rosario	1,649	1,870	1,960	1.27	3.28	502.74	570.12
Suclaban	408	584	610	3.65	3.15	129.52	185.40
Tangle	620	705	758	1.29	2.25	275.56	313.33
Total	53,491	69,441	73,030	2.64	98.97	540.48	701.64

** Excluding People from Resettlement

Source: Interim Report 1: The Study of Flood and Mudflow Control for Sacobia/Abacan River Draining from Mt. Pinatubo, June 1994

Table P.1.24 Urban-Rural Distribution, Mexico, 1980 & 1990

Barangay	Population		Percentage	
	1980	1990	1980	1990
Urban				
Parian	3,448	4,109	6.45	5.92
Lagundi	1,827	2,399	3.42	3.45
Masangsang	1,725	2,147	3.22	3.09
San Antonnio	3,063	3,916	5.73	5.64
San Carlos	1,520	2,118	2.84	3.05
Sto. Domingo	1,261	1,617	2.36	2.33
Sto. Rosario	1,649	1,870	3.08	2.69
Total	14,493	18,176	27.10	26.17
Rural				
Acli	850	979	1.59	1.41
Anao	2,338	2,962	4.37	4.27
Balas	1,170	1,664	2.19	2.40
Buenavista	559	753	1.05	1.08
Camuning	1,270	1,574	2.37	2.27
Cawayan	568	638	1.06	0.92
Concepcion	1,063	1,418	1.99	2.04
Culubasa	1,716	2,303	3.21	3.32
Divisoria	758	1,083	1.42	1.56
Dolores	738	1,057	1.38	1.52
Eden	347	362	0.65	0.52
Gandus	352	473	0.66	0.68
Lapuz	953	1,451	1.78	2.09
Laug	1,520	1,847	2.84	2.66
Masamat	568	728	1.06	1.05
Nueva Victoria	509	641	0.95	0.92
Pandacaqui	1,033	1,286	1.93	1.85
Pangatlan	1,085	1,352	2.03	1.95
Panipuan	544	726	1.02	1.05
Sabanilla	922	1,098	1.72	1.58
San Jose Malino	2,694	3,522	5.04	5.07
San Jose Matulid	1,410	1,958	2.64	2.82
San Juan	1,795	2,464	3.36	3.55
San Lorenzo	1,366	1,693	2.55	2.44
San Miguel	790	1,147	1.48	1.65
San Nicolas	1,174	1,465	2.19	2.11
San Pablo	1,071	1,335	2.00	1.92
San Patricio	2,183	2,896	4.08	4.17
San Rafael	405	635	0.76	0.91
San Roque	433	647	0.81	0.93
San Vicente	1,866	2,429	3.49	3.5
Sapang Maisac	1,712	2,387	3.20	3.44
Sta. Cruz	1,060	1,406	1.98	2.02
Sta. Maria	1,148	1,597	2.15	2.3
Suclaban	408	584	0.76	0.84
Tangle	620	705	1.16	1.02
Sub-Total	38,998	51,265	72.92	73.83
Total	53,491	69,441	100.02	100.00

Source: Interim Report 1: The Study on Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, June 1994.

Table P.1.25 Leading Causes of Morbidity and Morality in Mexico

Mortality	Morbility
1990	
Myocardial Infraction	U R T I
C V A	Bronchitis
Senility	Pneumonia
Bronchopneumonia	Influenza
P T B	Gastroenteritis
C A	Nutritional/Vitamin Defficiency
Congenital Heart Disease	Anemia
Accute Gastroenteritis	Heart Disease
Bronchial Asthma	Bronchial Asthma
Vehicular Accident	Skin Problems
1991	
Vascular Disease	Diarrhea
Pneumonia	Bronchitis
C A	Influenza
P T B	Pneumonia
H P N	T B (all forms)
Accident	Diseases of the Heart
Kidney Disease	Chikenpox
Diarrhea	Mensho
Septicemia	P T B
D M	Hepatitis
1992	
Cadiovascular Disease	U R T I
General Senelity	Antaminoes
C A (all forms)	Accute Gastroentiritis
Bronchopneumonia	Musculo-skeletal Disorder
C V A	Dermatitis
P T B	Infected wounds
Kidney Disease	U T I
G S W	Heart Disease
Koch's Disease	Eye Infection
V A	Ear Infection

Source: RHU I, Municipality of Mexico

Table P.1.26 Growth & Population Density, Angeles City, 1980 & 1990

Barangay	Population 1980	Population 1990	Growth Rate (%) 1980-1990	Land Area (sq. km.)	Density (per sq. km.) 1980	Density (per sq. km.) 1990
Agapito del Rosario	4,687	3,894	(1.84)	0.12	39,058	32,450
Amsic		3,628		1.61	0	2,253
Anunas	3,424	5,939	5.66	3.64	941	1,632
Balibago	24,328	29,791	2.05	2.66	9,146	11,200
Capaya II	2,475	4,392	5.90	2.56	967	1,716
Claro M. Recto	7,704	6,453	(1.76)	0.17	45,318	37,959
Cauayan	315	920	11.31	4.26	74	216
Cutcut	12,710	17,453	3.22	4.16	3,055	4,195
Cutud	838	1,290	4.41	1.92	436	672
Lourdes Northwest	11,361	11,534	0.15	0.38	29,897	30,353
Lourdes Sur	7,589	6,519	(1.51)	0.22	34,495	29,632
Lourdes Sur East	7,494	6,549	(1.34)	0.21	35,686	31,186
Malabañas	9,972	16,050	4.87	2.45	4,070	6,551
Margot	1,653	2,452	4.02	2.86	578	857
Mining	779	1,122	3.72	1.14	683	984
Ninoy Aquino (Marisol)		11,898		0.74	0	16,078
Pampang	2,848	5,727	7.24	4.44	641	1,290
Pandan	13,301	7,565	(5.49)	1.63	8,160	4,641
Pulung Cacutud	1,070	1,681	4.62	2.48	431	678
Pulung Maragul	4,103	8,649	7.74	2.22	1,848	3,896
Pulungbulu	7,463	10,295	3.27	1.61	4,635	6,394
Salapungan	6,104	6,649	0.86	0.26	23,477	25,573
San Jose	6,398	6,940	0.82	0.48	13,329	14,458
San Nicolas	4,379	3,532	(2.13)	0.19	23,047	18,589
Sta. Teresita	10,795	11,690	0.80	0.34	31,750	34,382
Sta. Trinidad	5,552	5,887	0.59	0.14	39,657	42,050
Sto. Cristo	2,793	3,857	3.28	1.55	1,802	2,488
Sto. Domingo	12,595	14,869	1.67	2.53	4,978	5,877
Sto. Rosario	3,930	4,105	0.44	0.56	7,018	7,330
Sapalibutad	2,131	2,812	2.81	2.75	775	1,023
Sapangbato	7,430	9,477	2.46	10.96	678	865
Tabun	688	1,515	8.21	0.83	829	1,825
Virgen Delos Remedios	1,925	1,551	(2.14)	0.08	24,063	19,388
Total	186,909	236,685	2.28	62.15	3,007	3,808

Source: Interim Report 1: The Study on Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, 1994.

Table P.1.27 Urban-Rural Distribution by Barangay Angeles City, 1980 & 1990

Barangay	Population		Percentage	
	1980	1990	1980	1990
Urban				
Agapito del Rosario	4,687	3,894	2.48	1.65
Amsic	-	3,628	-	1.53
Anunas	3,424	5,939	1.81	2.51
Balibago	24,328	29,791	12.88	12.59
Capaya II	2,475	4,392	1.31	1.86
Claro M. Recto	7,704	6,453	4.08	2.73
Cutcut	12,710	17,453	6.37	7.37
Lourdes Northwest	11,361	11,534	6.02	4.87
Lourdes Sur	7,589	6,519	4.02	2.75
Lourdes Sur East	7,494	6,549	3.97	2.77
Malabañas	9,972	16,050	5.28	6.78
Margot	1,653	2,452	0.88	1.04
Ninoy Aquino (Marisol)	-	11,898	-	5.03
Pampang	2,848	5,727	1.51	2.42
Pandan	13,301	7,565	7.04	3.20
Pulung Cacutud	1,070	1,681	0.57	0.71
Pulung Maragul	4,103	8,649	2.17	3.65
Pulungbulu	7,463	10,295	3.95	4.35
Salapungan	6,104	6,649	3.23	2.81
San Jose	6,398	6,940	3.39	2.93
San Nicolas	4,379	3,532	2.32	1.49
Sta. Teresita	10,795	11,690	5.72	4.94
Sta. Trinidad	5,552	5,887	2.94	2.49
Sto. Cristo	2,793	3,857	1.48	1.63
Sto. Domingo	12,595	14,869	6.67	6.28
Sto. Rosario	3,930	4,105	2.08	1.73
Sapangbato	7,430	9,477	3.93	4.00
Virgen Delos Remedios	1,925	1,551	1.02	0.66
Sub-Total	184,083	229,026	97.12	96.77
Rural				
Cauayan	315	920	0.17	0.39
Cutud	838	1,290	0.44	0.55
Mining	779	1,122	0.41	0.47
Sapalibutad	2,131	2,812	1.13	1.19
Tabun	688	1,515	0.36	0.36
Sub-Total	4,751	7,659	2.51	2.96
Total	188,834	236,685	99.63	99.73

Source: Interim Report 1: The Study on Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo. June, 1994

Table P.1.28 Population Distribution & Ratio By Sex-Age Groups, Angeles City 1980, 1990 & 1992

Age Group	Population Distribution by Sex						Sex Ratio		
	1980		1990		1992				
	Male	Female	Male	Female	Male	Female	1980	1990	1992
0 - 4	16,392	13,817	16,305	15,028	11,925	10,693	118.6	108.5	111.5
5 - 9	13,709	12,000	14,426	13,787	11,516	10,929	114.2	104.6	105.4
10 - 14	12,012	11,267	13,973	13,569	12,456	11,446	106.6	103.0	108.8
15 - 19	10,808	11,705	12,973	13,862	11,382	11,524	92.3	93.6	98.8
20 - 24	9,234	11,806	12,757	14,315	11,117	11,303	78.2	89.1	98.4
25 - 29	7,166	9,601	10,626	11,519	9,535	10,060	74.6	92.2	94.8
30 - 34	5,970	7,490	8,711	9,154	868	7,782	79.7	95.2	11.2
35 - 39	3,657	4,710	6,927	7,393	7,073	7,235	77.6	93.7	97.8
40 - 44	3,204	3,687	5,703	6,044	5,486	5,712	86.9	94.4	96.0
45 - 49	2,520	3,216	3,647	4,001	4,825	4,226	78.4	91.2	114.2
50 - 54	1,956	2,527	3,324	3,371	3,281	3,441	77.4	98.6	95.4
55 - 59	1,425	1,892	2,387	2,641	2,582	2,525	75.3	90.4	102.3
60 - 64	2,765	4,298	1,800	1,877	2,108	1,983	64.3	95.9	106.3
65 - 69			1,117	1,359	1,257	1,585		82.2	79.3
70 - 74			661	880	765	948		75.1	80.7
75 - 79			441	658	468	573		67.0	81.7
> 80			323	504	310	295		64.1	105.1
Total	90,818	98,016	116,101	119,962	96,954	102,260	64.3	96.8	94.8

Source: Socio-economic Profile, Angeles City, 1993

Table P.1.29 Number of Households by Barangay, Angeles City, 1992

Barangay	Population in 1992	No. of Households	Average Size of Household
Agapito del Rosario	3,842	752	5.11
Amsic	3,646	706	5.16
Anunas	5,519	1,225	4.51
Balibago	18,751	4,389	4.27
Capaya II	4,431	766	5.78
Claro M. Recto	4,768	856	5.57
Cuayan	891	179	4.98
Cutcut	13,215	2,401	5.50
Cutud	1,430	253	5.65
Lourdes Northwest	10,653	1,969	5.41
Lourdes Sur	6,473	1,248	5.19
Lourdes Sur East	5,377	1,082	4.97
Malabañas	16,345	3,673	4.45
Margot	1,995	347	5.75
Mining	1,116	199	5.61
Ninoy Aquino (Marisol)	10,782	2,063	5.23
Pampanga	7,919	1,573	5.03
Pandan	7,908	1,537	5.15
Pulung Cacutud	5,919	2,031	2.91
Pulung Maragul	9,447	1,094	8.64
Pulungbulu	11,111	1,803	6.16
Salapungan	4,791	929	5.16
San Jose	4,964	1,112	4.46
San Nicolas	3,643	620	5.88
Sta. Teresita	6,212	493	12.60
Sta. Trinidad	4,626	568	8.14
Sto. Cristo	2,746	1,170	2.35
Sto. Domingo	14,285	834	17.13
Sto. Rosario	5,667	487	11.64
Sapalibutad	2,902	1,074	2.70
Sapangbato	2,593	2,693	0.96
Tabun	1,506	275	5.48
Virgen Delos Remedios	1,363	286	4.77
Total	206,836	40,687	5.08

Table P.1.30 Leading Causes of Mortality and Infant Mortality, Angeles City. 1988-1993

a. Causes of Mortality

Mortality Causes:	Number	SDR per 100,000	Rank
Diseases of the Heart	318	128	1
Senility	201	81	2
Cancer	142	57.1	3
P.T.B.	123	49.46	4
Pneumonias	99	40	5
Accident	62	25	6
Premature	24	10	7
Diabetis	24	10	7
Uremia	21	8.44	9
Diarrhea	20	8.04	10

b. Causes of Infant Mortality

	1988 Rate/1000	1989 Rate/1000	1990 Rate/1000	1991 Rate/1000	1992 Rate/1000	1993 Rate/1000
Prematurity	6.71	5.62	5.6	3.8	3.79	2.82
Broncho-pneumonia	3.5	3.56	3.79	2.57	1.85	2.5
Gastro-Enteritis	1.26	0.56	0.79	0.06	1.05	0.54
Disease of the heart	1.17	0.66	0.35	0.8	0.26	0.43
Malnutrition	0.78	0.19	-	0.27	0.53	-
Asphyxia Neonatorum	0.78	0.47	0.79	0.35	0.53	0.54
Septicema	0.49	-	-	0.18	0.18	-
Measles	0.49	0.28	0.26	0.18	-	0.11
Meningitis	0.29	-	0.35	0.09	-	0.33
Bronchitis	0.19	0.09	-	-	-	0.22
Sepsis Neo	-	0.28	0.7	0.8	0.53	0.98
Hemorrhage	-	0.19	-	-	-	-
Syndrome	-	-	0.26	-	-	-
Tetanus Neo	-	-	0.18	-	-	-
Sepsis	-	-	-	-	0.18	-
Hydrocephalus	-	-	-	-	0.18	
Asthma	-	-	-	-	-	0.11

Source: City Health Office, Angeles City

Table P.1.31 Occupational Distribution by Sex, Angeles City, 1990

Occupational Group	Both Sexes	Male	Female
Office Workers	4,898	2,714	2,184
Professionals	4,555	1,961	2,594
Technicians & Associated Professionals	2,129	1,453	676
Clerks	5,462	2,669	2,793
Services & Shop Workers	8,975	4,292	4,683
Farmers, Forestry Workers & Fishermen	1,933	1,745	188
Craft & Related Workers	16,834	14,879	1,955
Plant & Machine Operators & Assemblers	8,439	8,375	64
Elementary Occupations	16,619	8,491	8,128
Non-gainful Occupations	66,507	18,518	47,989
Other Occupations N.E.C.	4,333	2,707	1,626
Occupation not stated	8,301	3,798	4,503
Total	148,985	71,602	77,383

Source: NSO, Socio-economic Profile, Angeles City. 1993

Table P.1.32 Population Growth Rate and Density by Barangay, Bamban, 1980 & 1990

Barangay	Population			Growth Rate (1980-1990)	Land Area (sq.km.)	Density (p/sq.km)	
	1980	1990	* 1993			1980	1990
Anupul	3,447	5,035	5,359	3.86	74.27	46.41	67.79
Banaba	4,095	5,695	6,412	3.35	7.82	523.66	728.26
Bangcu	164	216	665	2.79	11.73	13.98	18.41
Culubasa	162	271	1,024	5.28	15.63	10.36	17.34
De la Cruz	2,039	2,613	2,781	2.51	11.73	173.83	222.76
Lapaz	2,378	2,312	2,461	-0.28	3.91	608.18	591.3
San Vicente	594	1,201	1,500	7.29	46.91	12.66	25.6
Sto. Niño	594	986	1,380	5.20	66.45	8.94	14.84
Lourdes	3,464	5,033	5,358	3.81	31.27	110.78	160.95
Malonzo	637	811	1,824	2.44	15.64	40.73	51.85
Pacalcal	845	1,126	1,322	2.91	23.45	36.03	48.02
San Nicolas (Pob.)	4,039	5,499	5,853	3.13	37.09	108.9	148.26
San Pedro	1,408	2,069	2,202	3.92	11.78	119.52	175.64
San Rafael	383	684	728	5.97	19.54	19.6	35.01
San Roque	1,823	2,088	2,222	1.37	11.73	155.41	178.01
TOTAL	26,072	35,639	41,091	3.18	388.95	67.03	91.63

Source: Interim Report 1: The Study on Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo. June, 1994.
* Councilor Sergio Calayag, Municipal Councilor, Municipality of Bamban

Table P.1.33 Population Distribution in Urban-Rural, Bamban, 1980 & 1990

	Population		Proportion	
	1980	1990	1980	1990
URBAN				
Banaba	4,095	5,035	15.71	14.13
De la Cruz	2,039	2,613	7.82	7.33
Lapaz	2,378	2,312	9.12	6.49
Lourdes	3,464	5,033	13.29	14.12
San Nicolas (pob.)	4,039	5,499	15.49	15.43
San Roque	1,823	2,088	6.99	5.86
Urban Total	17,838	22,580	68	63
RURAL				
Anupul	3,447	5,035	13.22	14.13
Bangcu	164	216	0.63	0.61
Culubasa	162	271	0.62	0.76
San Vicente	594	1,201	2.28	3.37
Sto. Nino	594	986	2.28	2.77
Malonzo	637	811	2.44	2.28
Pacalcal	845	1,126	3.24	3.16
San Pedro	1,408	2,069	5.40	5.81
San Rafael	383	684	1.47	1.92
Rural Total	8,234	12,399	32	35

Source: Interim Report 1: The Study on Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo. June, 1994

Table P.1.34 Sex Ratio of the Population in Bamban, 1987

Barangay	Male	Female	Sex Ratio
Anupul	2,183	1,987	109.9
Banaba	2,445	2,509	97.4
Bangcu	96	104	92.3
Culubasa	98	98	100.0
De la Cruz	1,220	1,246	97.9
Lapaz	1,423	1,453	97.9
Lourdes	2,109	2,084	101.2
Malonzo	381	391	97.4
Pacalcal	514	509	101.0
San Nicolas (Pob.)	2,452	2,435	100.7
San Pedro	867	837	103.6
San Rafael	237	226	104.9
San Vicente	371	347	106.9
Sto. Niño	351	367	95.6
TOTAL	14,747	14,593	101.1

Table P.1.35 Leading Causes of Morbidity and Mortality in Bamban

Causes of Morbidity	Number	Causes of Mortality	Number
		1990	
Upper Respiratory Tract Infection	6,004	Cardiovascular Disease	33
Parasitism	1,783	Pneumonia (all forms)	24
Anemia	525	Pulmonary Tuberculosis	13
Diarrheal Cases	505	Cancer (all forms)	10
Skin Allergy	350	Artherio Sclerosis Heart Disease	2
Malnutrition	247	Renal Pathology	1
Gastitis	213		
Influenza	192		
Hypertension	150		
Error of Refraction	112		
		1991	
Upper Respiratory Infection	8,783	Cardiovascular Disease	38
Diarrheal Cases	1,445	Artherio Sclerosis Heart Disease	12
Dermatitis	1,101	Bronchopneumonia	12
Infected Wounds	783	Cancer (all forms)	12
Parasitism	738	P T B	7
Vitamim Deficiency	698	Renal Pathology	4
Anemia	579		
Gastitis/Hyperacidity	528		
Tension Headache	314		
Abcess	302		
		1992	
U R I	9,269	Artherio Sclerosis Heart Disease	18
Dermatitis	1,750	Myocardial Infraction	18
Diarrhea	1,431	Bronchopneumonia	12
Anemia	926	Cancer (all forms)	11
Hyperacidity/Gastitis	759	Cerebro Vascular Accident	6
Vitamim Deficiency	722	Renal Failure	5
Parasitism	705	Congestive Heart Failure	4
Tension Headache	606	Drowning	3
Infected Wounds	483	P T B	3
Athritis	230		
		1993	
U R I	10,713	Myocardial Infraction	20
Vitamim Deficiency	2,096	A S H D	18
Dermatitis	2,021	Celebro Vascular Accident	11
Gastitis/Hyperacidity	1,418	KOCHS Pulmonary	9
Parasitism	921	Bronchopneumonia	7
Diarrhea	921	Cervical Tumor	5
Infected Wound	787	COPD-Bronchial Asthma	4
Hypertension	349	Irreversible Shock Multiple Fracture	4
Bronchial Asthma	330	Drowning	4
Athritis	272	Renal Failure	1
		Pancreatitis	1

Source: Rural Health Unit, Municipality of Bamban.

Table P.1.36 Population, Growth Rate & Density by Barangay in Concepcion, 1980, 1990 & 1993

Barangay	Population			Growth Rate (1980-1990)	Land Area (sq. km.)	Density	
	1980	1990	*1993			1980	1990
Alfonso	4,225	4,740	4,917	1.16	1.67	2,530	2,838
Balutu	2,468	2,943	3,078	1.78	5.39	458	546
Cafe	1,766	2,277	2,506	2.57	4.73	373	481
Calius Gueco	699	904	1,150	2.61	2.59	270	270
Caluluan	2,393	3,206	3,496	2.97	3.85	622	833
Castillo	1,508	2,155	2,497	3.63	8.78	172	245
Corazon de Jesus	1,155	1,523	2,014	2.80	3.17	364	364
Culatingan	1,842	2,509	2,870	3.14	5.13	359	359
Dungan	502	713	1,225	3.57	1.24	405	575
Dutung a Matas	1,138	1,538	2,329	3.06	2.34	486	486
Green Village		1,611	1,883		0.74		
Lilibangan	559	785	980	3.45	2.97	188	188
Mabilog	1,404	1,728	1,862	2.10	6.15	228	281
Magao	1,710	2,431	2,621	3.58	7.20	238	338
Malupa	979	1,463	1,881	4.10	3.46	283	423
Minane	3,166	3,550	3,983	1.15	0.98	3,231	3,622
Panalicsian	819	894	1,040	0.88	2.24	366	366
Pando	1,194	1,546	1,704	2.62	6.42	186	241
Parang			2,500				
Parulung	834	1,004	1,272	1.87	1.56	535	644
Pitabunan	935	1,152	1,358	2.11	2.83	330	330
San Agustin			3,409				
San Antonio	1,559	1,998	2,562	2.51	4.24	368	368
San Bartolome	1,207	1,634	1,855	3.08	4.98	242	242
San Francisco	3,532	4,374	4,740	2.16	6.59	536	536
San Isidro	1,848	2,139	2,268	1.47	5.46	338	338
San Jose	6,535	7,591	7,920	1.51	0.56	11,670	13,555
San Juan	1,409	1,986	1,790	3.49	3.34	422	595
San Martin	934	1,220	2,280	2.71	3.44	272	272
San Nicolas	3,798	3,891	4,359	0.24	0.99	3,836	3,836
San Nicolas Balas	1,680	2,046	2,282	1.99	5.51	305	305
San Vicente	703	1,049	1,350	4.08	3.37	209	209
Santiago	2,471	3,113	3,378	2.34	4.44	557	701
Sta. Cruz	2,428	3,309	3,806	3.14	5.85	415	415
Sta. Maria	485	649	985	2.96	1.14	425	425
Sta. Monica	3,366	4,231	4,723	2.31	7.34	459	459
Sta. Rita	4,172	4,885	3,304	1.59	4.02	1,038	1,038
Sta. Rosa	1,754	3,012	3,181	5.56	3.30	532	532
Sto. Cristo	737	879	939	1.78	1.78	414	414
Sto. Niño	1,265	1,766	2,292	3.39	4.17	303	303
Sto. Rosario	906	1,269	1,803	3.43	2.01	451	451
Talimundu Marimla	991	1,112	1,440	1.16	3.29	301	301
Talimundu San Miguel	1,287	1,713	1,833	2.90	3.25	3	3
Telabanca	1,795	2,249	2,457	2.28	4.95	363	363
Tinang	2,288	2,989	3,015	2.71	3.35	683	892
TOTAL	76,446	97,776	115,138	2.49	160.78	475	608

Source: Interim Report 1: The Study on Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo. June, 1994.
* Socio-economic Profile, Municipality of Concepcion (as of May, 1993)

Table P.1.37 Urban & Rural Distribution of Population in Concepcion in 1980, 1990 and 1993

	Population			Percentage		
	1980	1990	1993	1980	1990	1993
URBAN						
San Jose	6,535	7,591	7,920	9	8	7
San Nicolas	3,798	3,891	4,360	5	4	4
Urban Total	10,333	11,482	12,280	14	8	7
RURAL						
Alfonso	4,225	4,740	4,917	6	5	4
Balutu	2,468	2,943	3,078	3	3	3
Cafe	1,766	2,277	2,506	2	2	2
Calius Gueco	699	904	1,150	1	1	1
Caluluan	2,393	3,206	3,496	3	3	3
Castillo	1,508	2,155	2,497	2	2	2
Corazon de Jesus	1,155	1,523	2,014	2	2	2
Culatingan	1,842	2,509	2,870	2	3	2
Dungan	502	713	1,225	1	1	1
Dutung a Matas	1,138	1,538	2,329	1	2	2
Green Village	-	1,611	1,883	-	2	2
Lilibangan	559	785	980	1	1	1
Mabilog	1,404	1,728	1,862	2	2	2
Magao	1,710	2,431	2,621	2	2	2
Malupa	979	1,463	1,881	1	2	2
Minane	3,166	3,550	3,983	4	4	3
Panalicsican	819	894	1,040	1	1	1
Pando	1,194	1,546	1,704	2	2	1
Parang	-	-	2,500	-	-	2
Parulung	834	1,004	1,272	1	1	1
Pitabunan	935	1,152	1,358	1	1	1
San Agustin	-	-	3,409	-	-	3
San Antonio	1,559	1,998	2,562	2	2	2
San Bartolome	1,207	1,634	1,855	2	2	2
San Francisco	3,532	4,374	4,740	5	4	4
San Isidro	1,848	2,139	2,268	2	2	2
San Juan	1,409	2,986	1,790	2	2	2
San Martin	934	1,220	2,280	1	1	2
San Nicolas Balas	1,680	2,046	2,282	2	2	2
San Vicente	703	1,049	1,350	1	1	1
Santiago	2,471	3,113	3,378	3	3	3
Sta. Cruz	2,428	3,309	3,806	3	3	3
Sta. Maria	485	649	985	1	1	1
Sta. Monica	3,366	4,231	4,723	4	4	4
Sta. Rita	4,172	4,885	3,304	5	5	3
Sta. Rosa	1,754	3,012	3,181	2	3	3
Sto. Cristo	737	879	939	1	1	1
Sto. Niño	1,265	1,766	2,292	2	2	2
Sto. Rosario	906	1,269	1,803	1	1	2
Talimunduc Marimla	991	1,112	1,440	1	1	1
Talimunduc San Miguel	1,287	1,713	1,833	2	2	2
Telabanca	1,795	2,249	2,457	2	2	2
Tinang	2,288	2,989	3,015	3	3	3
Rural total	66,113	87,294	102,858	86	88	89

Source: Interim Report 1:"The Study on Flood and Mudflow Control for Sacobia/Bamban and Abacan River Draining from Mt. Pinatubo. June, 1994.
* Socio-economic Profile, Municipality of Concepcion May 1990.

Table P.1.38 Sex Ratio of Population in Concepcion, 1993

Barangay	Male	Female	Sex Ratio
Alfonso	2,392	2,525	94.73
Balutu	1,792	1,286	139.35
Cafe	1,245	1,261	98.73
Calius Gueco	541	609	88.83
Caluluan	1,950	1,546	126.13
Castillo	1,258	1,239	101.53
Corazon de Jesus	1,011	1,003	100.8
Culatingan	1,466	1,404	104.42
Dungan	648	577	112.31
Dutung a Matas	1,064	1,265	84.11
Green Village	983	900	109.22
Lilibangan	539	441	122.22
Mabilog	1,117	745	149.93
Magao	1,349	1,272	106.05
Malupa	854	1,027	83.15
Minane	1,934	2,049	94.39
Panalicsican	570	470	121.28
Pando	927	777	119.31
Parang	1,305	1,195	109.21
Parulung	745	527	141.37
Pitabunan	716	642	111.53
San Agustin	1,552	1,857	83.58
San Antonio	1,314	1,248	105.29
San Bartolome	1,002	853	117.47
San Francisco	2,365	2,375	99.58
San Isidro	980	1,288	76.09
San Jose	3,902	4,018	97.11
San Juan	855	935	91.44
San Martin	1,431	849	168.55
San Nicolas	1,744	2,615	66.69
San Nicolas Balas	1,118	1,164	96.05
San Vicente	652	698	93.41
Santiago	1,827	1,551	117.79
Sta. Cruz	1,886	1,920	98.23
Sta. Maria	515	470	109.57
Sta. Monica	2,542	2,181	116.55
Sta. Rita	1,610	1,694	95.04
Sta. Rosa	1,551	1,630	95.15
Sto. Cristo	460	479	96.03
Sto. Niño	1,112	1,180	94.24
Sto. Rosario	907	896	101.23
Talimundue Marimla	580	860	67.44
Talimundue San Miguel	950	883	107.59
Telabanca	1,237	1,220	101.39
Tinang	1,582	1,433	110.40
TOTAL	58,080	57,058	101.79

Source: Socio-economic Profile, Conceptioin, May 1990.

Table P.1.39 Leading Causes of Morbidity and Mortality, Concepcion, 1992

	No. of Cases	Rate
Causes of Morbidity		
Acute Respiratory Infraction	6,150	113
Gastrointestinal Disease	1,419	26
Intestinal Parasitism	1,330	24
Anemia	1,097	20
Physical Examination	1,052	19
Skin Problem	848	14
Vitamin Deficiency	764	14
Musculo-intestinal Disorder	361	7
Heart Disease	220	4
Influenza	214	4
Mortality Causes		
P T B	19	3
Myocardial Infraction	18	3
Cardio Vascular Disorder	17	3
Pneumonia	13	2
Cancer (all forms)	13	2
Chronic Obst. Pulmonary Disease	12	2
Bronchopneumonia	8	1
Cardio Vascular Accident	4	1
Diabetis Mellitus	3	1
Hypertension	3	1

Source: Rural Health Unit I & II, Municipality of Concepcion.

Table P.1.40 Land Use before and after the Mt. Pinatubo Eruption in the Study Area

Town/City	Year	Residential	Industrial	Commercial	Institutional	Military	Infrastructure and River	Agriculture	Forest	Open Space	Total
CONCEPCION	1980	2,021	985				902	19,946			23,854
								11,504			11,504
BAMBAN	1980										
ANGELES	1975			124							124
	1992	2,129	79	282	105			3,491		74	6,160
MABALACAT	1985	2,222	245	100	50	5,275		4,652	2,618	100	15,262
	1992	2,371	52	132		5,757		4,311		2,640	15,263
ARAYAT	1991	337	27		19		113	11,361	5,827	10	17,694
MAGALANG	1993								127	317	444

Table P.1.41 Agricultural Land Use Comparing Pre-eruption and Post-eruption in the Study Area

Land Use	Pampanga		Tarlac	
	Pre Eruption	Post Eruption	Pre Eruption	Post Eruption
Agricultural Area	112,850	100,482	140,130	131,646
Affected Area		3,939		5,754
Total Land Area	218,068	218,068	305,345	305,345
Percentage	52	46	46	43

Source : Bureau of Soils and Water Management, Dept. of Agriculture, 1994.

Table P.1.42 Areas Planted to Various Crops, Pre-Pinatubo and Post-Pinatubo of Pampanga and Tarlac

Crops	Pampanga				Tarlac			
	Pre-Eruption		Post-Eruption		Pre-Eruption		Post-Eruption	
	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%
TOTAL	112,893	100.00%	100,041	100.0	140,147	100.0	131,363	100.0
Irrigated Paddy Rice	56,874	50.38%	42,939	42.9	59,328	42.3	46,150	35.1
Rainfall Paddy Rice	25,170	22.30%	22,394	22.4	52,236	37.3	52,620	40.1
Upland Rice	1,813	1.61%	0	-	0	-	0	-
Corn	274	0.24%	2,335	2.3	1,436	1.0	9,470	7.2
Mungbean	0	0.00%	0	-	248	0.2	0	-
Eggplant	0	0.00%	0	-	19	0.0	163	0.1
Tomato	0	0.00%	0	-	19	0.0	0	-
String Beans	283	0.25%	49	0.0	105	0.1	0	-
Ampalaya	283	0.25%	0	-	24	0.0	0	-
Cassava	2,691	2.38%	1,023	1.0	0	-	0	-
Sweet Potato	1,874	1.66%	0	-	5,108	3.6	0	-
Turnips	275	0.24%	0	-	15	0.0	0	-
Rootcrops	0	0.00%	0	-	13	0.0	0	-
Melon	0	0.00%	0	-	248	0.2	0	-
Mango	0	0.00%	47	0.0	17	0.0	17	0.0
Banana	185	0.16%	0	-	397	0.3	0	-
Mixed Fruit Trees	1,056	0.94%	1,458	1.5	186	0.1	1,557	1.2
Cotton	0	0.00%	0	-	13	0.0	0	-
Tobacco	13	0.01%	0	-	212	0.2	499	0.4
Sugarcane	22,089	19.57%	29,796	29.8	20,496	14.6	20,887	15.9
Coconut	13	0.01%	0	-	27	0.0	0	-

Source : Bureau of Soils and Water Management, Department of Agriculture, 1994

Table P.1.43 Pasture and Aquaculture Areas in the Study Area

a. Pasture

(ha)

Province	Land Area
Tarlac	68,704
Pampanga	13,937

Source: Bureau of Soils and Water Management,
Department of Agriculture, 1992.

b. Aquacultural Areas

(ha)

Province	Wetland
Tarlac	352
Pampanga	40,681

Source: Bureau of Soils and Water Management,
Department of Agriculture, 1992.

Table P.1.44 Livestock and Poultry, Pre-eruption and Post-eruption in Pampanga and Tarlac

Animals	Pampanga				Tarlac			
	Pre-eruption			Post-eruption	Pre-eruption			Post-eruption
	1988	1989	1990	1991	1988	1989	1990	1991
Carabao	37,650	39,980	31,570	30,224	65,440	68,400	64,350	51,772
Cattle	2,630	3,430	4,080	4,505	30,100	37,630	37,790	28,945
Hog	141,350	140,890	156,970	166,991	131,200	133,340	118,020	154,230
Chicken	1,611,900	2,046,101	2,767,980	2,597,880	1,214,910	1,033,050	1,204,890	930,790
Goat	18,990	12,070	11,390	46,860	40,250	66,220	59,820	46,860
Duck	194,050	283,490	260,320	256,280	170,520	176,580	508,700	843,530

Source: Bureau of Agricultural Statistics, Dept. of Agriculture

Table P.1.45 List of Wildlife Species Observed and Recorded in the Study Area

Species	Common Name	Habitat		
		Town/Villages	Grassland	Forest
I. MAMMALS:				
1. Rattus Mindanensis	Phil. Ricefield Rat	x	x	x
2. Rattus exulans	Pacific Island Rat	x	x	x
3. Sus philippensis	Phil. Warty Pig	-	-	x
II. BIRDS				
1. Haliastur indus	Brahminy Kite	-	x	x
2. Coturnis chinensis	Painted Quail	-	x	-
3. Phapitreron leucotis	Brown Fruit Dove	-	-	x
4. Geopelia striata	Zebra Dove	-	x	x
5. Loriculus philippensis	Phil Hanging Parakeet	-	-	x
6. Centropus viridis	Philippine Coucal	-	x	x
7. Collocalia esculenta	Glossy Swiftlet	-	x	x
8. Merops viridis	Bee-Eater	-	x	x
9. Hirundo rustica	Barn Swallow	-	x	x
10 Hirundo striolata	Mosque Swallow	-	x	x
11 Hirundo tahitica	Pacfic Swallow	-	x	x
12. Oriolus chinensis	Black-naped Oriole	-	x	x
13. Corvus macrorhynchos	Large-billed Crow	x	x	x
14. Pycnonotus goiavier	Yellow-vented Bulbul	x	x	x
15. Hypsipetes philippinus	Philippine Bulbul	-	-	x
16. Saxicola caprata	Pied Chat	-	x	-
17. Megalurus palustris	Canegrass Warbler	-	x	x
18. Cisticola exilis	Fantail-Warbler	-	x	x
19. Orthotomus atrogularis	Common Tailorbird	-	-	x
20. Rhipidura cyaniceps	Blue-headed Fantail	-	-	x
21. Anthus novaeseelandiae	Richard's Pipit	-	x	-
22. Artamus leucorhynchus	Woodswallow	-	x	x
23. Lanius cristatus	Brown Shrike	-	x	-
24. Lanius schach	Scharch's Shrike	-	x	x
25. Dicaeum hypoleucum	White-bellied Flowerpecker	-	-	x
26. Zosterops meyeni	Philippine White-eye	-	-	x
27. Passer montanus	Tree Sparrow	x	x	-
28. Lonchura malacca	Chestnut Munia	-	x	-
29. Lochura punctulata	Nutmeg Munia	-	x	-
30. Lochura leucogastra	White-bellied Munia	x	x	-
III. REPTILES:				
A. Lizards				
1. Lochura leucogastra	Spiny-tailed House Gecko	x	x	x
2. Gekko gecko	Towkay Tecko	x	x	x
3. Draco spilopterus	Flying Lizard	-	-	x
4. Mabuya multifasciata	Common Ground Skink	-	x	x
5. Varanus salvator	Common Monitor Lizard	-	x	x
B. Snakes:				
6. Dendrelaphis terrificus	Common Grass Snake	-	x	x
7. Elaphe erythrura	Red-tailed Rat Snake	x	x	x
8. Lycodon aulicus	Common House Snake	x	x	-
9. Naja naja philippensis	Philippine Cobra	-	x	x
10. Ophiophagus hannah	King Cobra	-	x	x
11. Python reticulatus	Reticulated Python	-	x	x
C. Turltes:				
12. Coura amboinensis	Common Pond Turtle	-	-	x
IV. AMPHIBIANS:				
1. Bufo marinus	Marine Toad	x	x	-
2. Rana cancrivora	Estuarine Frog	x	x	-
3. Rana limnocharis	Ricefield Frog	x	-	-

Table P.1.46 Bird Species Recorded in Candaba Swamp

Species	Common Name	Date and Place of Recovery
1. Bubulcus ibis	Cattle Egret	28 Nov. 1968 - San Miguel, Bulacan
2. Egretta garzetta	Little Egret	24 April 1969 - Arayat, Pampanga
3. Egretta intermedia	Intermediate Egret	4 Dec. 1965 - San Luis, Pampanga
		21 Dec. 1965 - Hagonoy, Bulacan
		16 May 1967 - Masantol, Pampanga
4. Ixobrychus sinensis	Chinese Little Bittem	18 May 1968 - Conception, Tarlac
5. Butastur indicus	Gray-faced Buzzard	15 Dec. 1967 - Pulilan, Bulacan
		28 Nov. 1968 - Santa Maria, Bulacan
6. Coturnix chinensis	Painted Quail	10 March 1972 - San Miguel, Bulacan
7. Gallinula chloropus	Moorhen	25 Aug. 1965 - Mangabul Swamp, Tarlac
8. Poliolimnas cinereus	White-browed Rail	18 Jan. 1972 - Capas, Tarlac
		28 July 1972 - San Miguel, Tarlac
9. Rallus striatus	Slaty-breasted Rail	25 Dec. 1967 - San Miguel, Bulacan
10. Actitis hypoleucos	Common Sandpiper	11 Nov. 1964 - Baliwag, Bulacan

Table P.1.47 Plant Species in the Study Area (1/5)

a. Wetland Species

Scientific Name	Local/English Name
Fern	
Diplazium esculentum (Retz.) Sw	Pakong Ilog
Monocot	
Cyperus compactus Retz.	Bayong
C.iria L.	Taga-taga
Fimbristylis dichotoma (L.) Vahl	Tayuk-tayuk
F.miliacea (L.) Vahl	Ubod-ubod
F. littoralis Gaud.	Gumi
Scirpus grossus L.f.	Tikiw
Brachiaria distachya (L.) Stapf	-
B.mutica (Forsk.) Stapf	Para Grass
Coix lacryma-jobi L.	Tigpi
Cynodon dactylon (L.) Pers	Kawad-kawad
Echinochloa colona (L.) Link	-
Eriochloa procera (Retz.) C.E.Hubb.	-
Leptochloa chinensis (L.) Nees	-
Panicum repens L.	Luya-luya
Phragmites karka	Tambo
Typha angutifolia	Balangot
Dicot	
Heliotropium indicum L.	Hikau-hiauan
Eclipta zippeliana (Blm.) Kostern.	-
Sphaeranthus africanus L.	Boto-botonisan
Vernonia cinerea (L.) Less.	Bulak-manok
Ludwigia octobalvis (Jacq.) Raven	-
L.sessiliflora (Mich.) Raven	-
Legume	
Aeschynomene americana L.	-
A.indica L.	Makahiyang lalaki
Macroptilium lathyroides (L.) Urb.	-
Pueraria lobata (Willd.) ohwi	-

b. Species Found in the Cultivated Land

Scientific Name	Local/English Name
Monocot	
Commelina benghalensis L.	Alikbangon
C.diffusa Burm.f.	Tari-tari
Murdania nodiflora (L.) Brenan	-
Cyperus rotundus L.	Mutah
Dactyloctinum aegyptium (L) Willd	Damong Balang
Digitaria ciliaris (Retz.) Koel.	Saka-saka
Eleusine indica (L) Gaertn.	Paragiw
Paspalidium flavidum (Retz.) A.Camus	Lisang Lalalaw
Paspalum conjugatum Berg.	Kulape
Rottboellia cochinchinensis (Lour) Clayton	Aguingay
Themeda arundinacea (Roxb.) A.Camus	Malatanglad

Table P.1.47 Plant Species in the Study Area (2/5)

b. Species Found in the Cultivated Land (continued)

Scientific Name	Local/English Name
Dicot	
Cleome gynandra L.	-
C.rutidosperma DC	-
Ageratum conyzoides L.	Bulak-manok
Crassocephalum crepedioides (Benth.) S.Moore	Bulak-manok
Emilia sonchifolia (L.) DC.ex Wight	Tagulinaw
E.prenanthoides DC.	-
Synedrella nodiflora (L.) Gaertn.	Tuhod-manok
Ipomoea triloba (L.)	Kamo-kamotihan
Acalypha indica L.	Bugos
Euphorbia hirta L.	Gatas-gatas
Euphorbia hypericifolia L.	-
Euphorbia prostrata Ait.	-
Ficus nota (Blco.) Merr.	Tibig
F.septica Burm.f.	Hawili
Boerhaavia erecta L.	-
Biophytum sensitivum (L.) DC.	Niyog-niyugan
Oxalis corniculata L.	Taingang-daga
Piper loheri DC.	Litlit
Piperomia pellucida (L.) H.B.K.	Pansit-pancitan
Borreria alata (Aubl.) DC.	-
B.laevis (Lam) Griseb.	-
Hedryotis corymbosa (L.) Lam.	Mabulaolasiman
Lindemia crustacea (L.) F.M.	-
Scoparia dulcis L.	Mala-anis
Physalis angulata L.	Putok-putokan
Centella asiatica (L.) Urb.	Takip-kohol
Laportea interrupta	Lipang Aso
Legume	
Desmodium procumbens (Mill.) A.S.Hitchc.	-
D.scorpiurus (Sw.) Desv.	-
D.triflorum (L.) DC.	Pakpak-langaw
Macroptilium atropureum (DC.) Urb.	Siratro

c. Open Grazing Land/Waste Land Species

Scientific Name	Local/English Name
Fern	
Nephrolepsis hirsutula (Forst.)Presl	-
Pteridium aquilinum (L.) Kuhn.	Bracken fern
Dicranopteris linearis	-
Pityrogramma calomelanos (L.) Ling	-
Christella arida (Don) Holtt.	-
Monocot	
Bulbostylis barbata (Benth)	-
Rhynchospora rubra (lour.) Makino	Rakido
Dioscorea hispida Dennst	Nami
Curcuma zedoaria	-

Table P.1.47 Plant Species in the Study Area (3/5)

c. Open Grazing Land/Waste Land Species (continued)

Scientific Name	Local/English Name
Kolowratia elegans	Tagbak
Alloteropsis semialata (R.Br.) Hitchc.	-
Cenchrus echinatus L.	Burr Grass
Chloris barbata Sw	Kros-krosan
Chrysopogon aciculatus (Retz.) Sw	Amorseco
Coelocachis glandulosa (Trin.) Stapf	-
Eragostis cumingii Steud.	-
Areca cathecu L.	Bunga
Arenga pinnata (Wurmb.) Merr	Kaong
Caryota cumingii Lodd ex Mart.	Pugahan
Dicot	
Barleria prionites	-
Achyranthes aspera L.	Danggod
Gomphrena celosioides Mart.	Botonisan
Tournefortia sarmentosa Lam.	-
Spathodea campanulata Beauv.	Pasirit
Capparis micravantha DC.	Dayap Gubat
Legume	
Bauhinia malabarica Roxb.	Alibangbang
Phanera integrifolia	-
Senna tora (L.)	Balatong Aso
Mimosa diplotrica C.Wright ex Sawvalle	Makahiyang-lalaki
M.pudica L.	Makahiya
Pithecellobium dulce (Roxb.) Benth.	Kamatsile
Samanea saman (Jacq.) Merr.	Akasia/Acasia
Abrus precatorius L.	Saga
Alysicarpus bupleurifolius (L.) DC	-
A. ovalifolium (Schum.) Leonard	-
A. vaginalis (L.) DC	Banig Usa
Cajanus cajan (L.) Millsp.	Kadios
Calopogonium mucunoides Desv.	-
Centrosema pubescens Benth.	-
Crotalaria incana L.	Putok-putokan
C.pallida Ait.	-
C.quinquefolia L.	Katanda
Dalea cliffortiana Willd.	Agogo
Derris polyantha Park.	Tubli
Flemingia strobilifera (L.) R.Br.ex Aiton	Tabang Bayawak
Gliricidia sepium (Jacq.) Kunth ex Walp	Kakawati
Indigofera hirsuta L.	-
I.suffruticosa Mill.	-
Phyllodium pulchellum (L.) Desv.	Payang-payang
Sesbania grandiflora (L.) Pers.	Katuray

Table P.1.47 Plant Species in the Study Area (4/5)

d. Species Found in the Secondary Forest Area

Scientific Name	Local/English Name
Fern	
Cyathea callosa Christ.	Pakong Kahoy
C.contaminans (wall.ex Hook) Copel.	Pakong Kahoy
Hilmintostachys zeylanica	Tukod Langit
Lygodium flexuosum (L.) Sw	Nito
L.japonicum (Thunb.) Sw	Nito
Monocot	
Alocacia macrorrhiza (L.) G.Don	Biga
Amorphophallus campanulatus (Roxb.) Blem.ex Decne	Pungapong
Homalomena philippinensis Engl.	Alupayi
Rhaphidophora pinnata (L.) Schott	Lukmoy
Scleria lighosperma (L.) Sw	Arat
S.scrobiculata Nees & Mey ex Nees	Arat
Dioscorea bulbifera L.	Pakit
D.hispida Dennst	Nami
Donax cannaeformis (Forst.) K.Schum	Bamban
Areca catechu L.	Buyo
Arenga pinnata (Wurmb.) Merr.	Kaong
Caryota cumingii Lodd ex Mart. Calamus	Pugahan
Schizostachyum lima (Blco.) Merr.	Anos
S. lumampao (Blco.) Merr.	Usiw
Thysanolaena latifolia (Hornem) Honda	Tambo
Alpinia brevilabres Presl.	-
Kolouratia elegans Presl.	Tagbak
Dicot	
Anacardium occidentale L.	Kasoy
Bucanania arborescens Blm.	Balin Hasay
Dracontomelon dao (Blco.) Merr.	Dao
Mangifera indica Blco.	Mango
Semicarpus cuneiforme Blco	Liga
Spondias pinnata (L.f.) Kurz.	Alubihon
Alstonia scholaris (L.) R.Br.	Dita
Ichnocarpus volubilis (Lour.) Merr.	Baging Bubat
Voacanga globosa (Blaco.) Merr.	Bayang-usa
Wrightia laniti (Blco.) Merr.	Laniti
Polyscias nodosa (Blaco.) Merr. & Rolfe	Galamayamo
Keinhovia hospita L.	Tanag
Prerospermum diversifoium Blm.	Bayok
P,obliquum Blco.	Kulatingan
Diplodiscus paniculatus Turcz.	Balobo
Greqia eriocarpa Juss	Bariuan
Trema orientalis (L.) Blm.	Anabiong
Celtis philippensis Blco.	Malaikmo
Dendrochnide meyeniana (Walp) Chew	Lipang Kalabaw
Leucosyke capitella (Poir.) Wedd.	Alagasi
Pipturus arborescens (Link) C.B.Rob.	Dalunot
Clerodendron villosum Blm.	Anoran
Gmelina arborea Roxb.	Yamane

Table P.1.47 Plant Species in the Study Area (5/5)

d. Species Found in the Secondary Forest Area (continued)

Scientific Name	Local/English Name
Premna Odorata Blco.	Alagan
Legume	
Bauhinia malabarica Roxb.	Alibambang
Phanera integrifolia	-
Sindora supa Merr.	Supa
Entada phaseoloides (L.) Merr.	Gugo
Parkia roxburghii G.Don	Kupang
Pithecellobum dulce (Roxb.) Benth	Kamachili
Samanea saman (Jacq.) Merr.	Akasia/Acasia
Gliricidia sepium (Jacq.) Kunth ex Walp	Kakawati

Table P.1.48 Species for Reforestation in the Study Area

Scientific Name	Local/English Name
Casuarina equisetifolia J.R.& G.Foster	Agoho
Serialbizia acle (Blco.) Kosterns.	Akle
Eucalyptus deglupta Blume	Bagras
Bambusa vulgaris Schrad .ex Wendl.	Kauayan-kiling
Pinus kesiya Royle ex Gordon	Benguet Pine
Acasia auriculiformis A.Cunn. ex Benth.	Japanese Acasia
Gliricidia sepium (Jacq.) Kunth. ex Walp.	Kakawati
Sesbania grandiflora (L.) Pers.	Katuray
Acasia mangium Willd.	Mangium
Pterocurpus inducus Willd.	Narra
Samanea saman (Jacq.) Merr.	Rain Tree
Eucalyptus camaldulensis Dehnh.	Red River Gum
Gmalina arborea Roxb.	Yamane

FIGURES

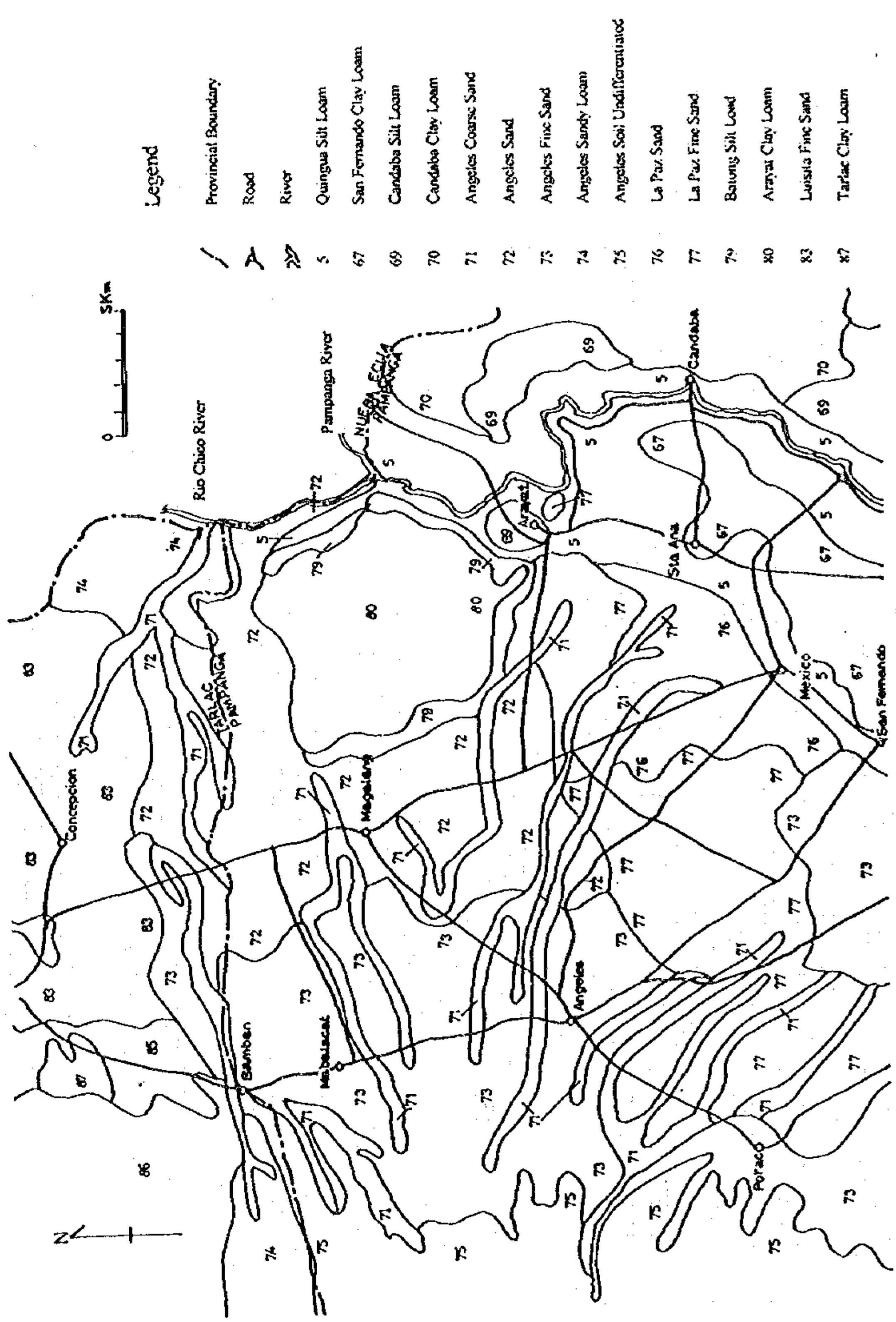

Figure P.1

Soil Map of the Study Area

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

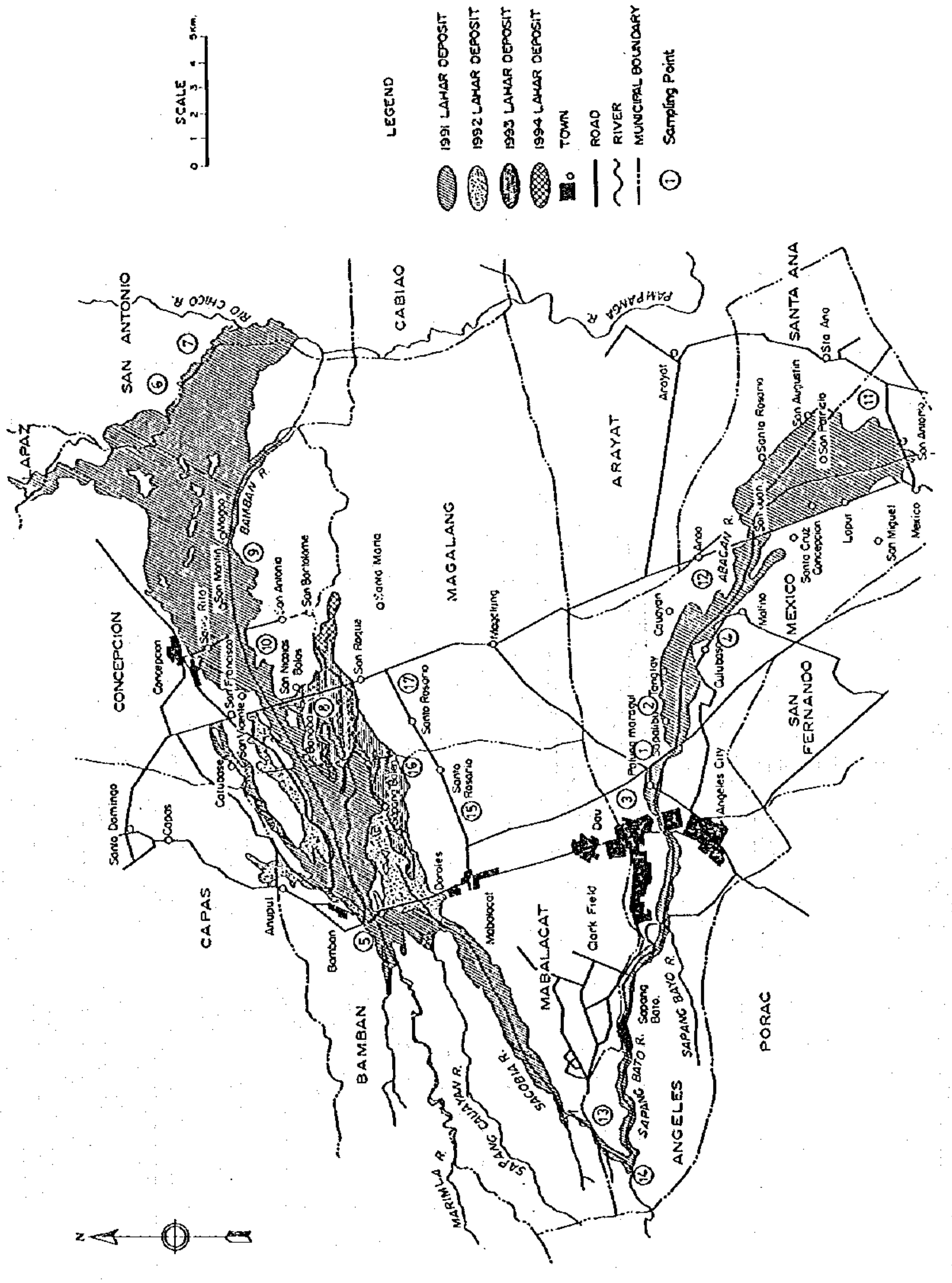

Figure P.2

Soil Sampling Locations in the Study Area

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
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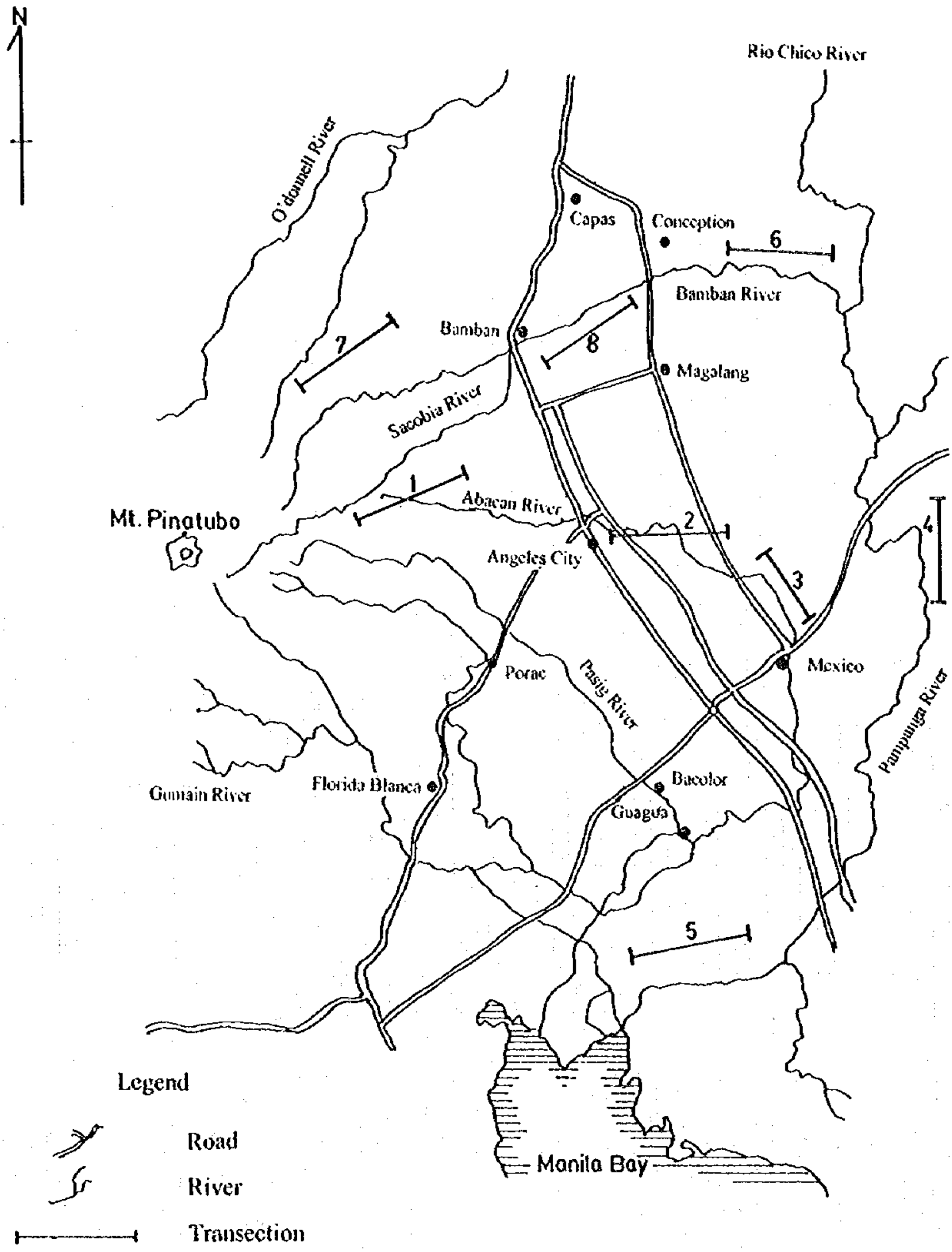

Figure P.3

Transections of the Wildlife Observation in the Study Area

THE GOVERNMENT OF THE PHILIPPINES THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

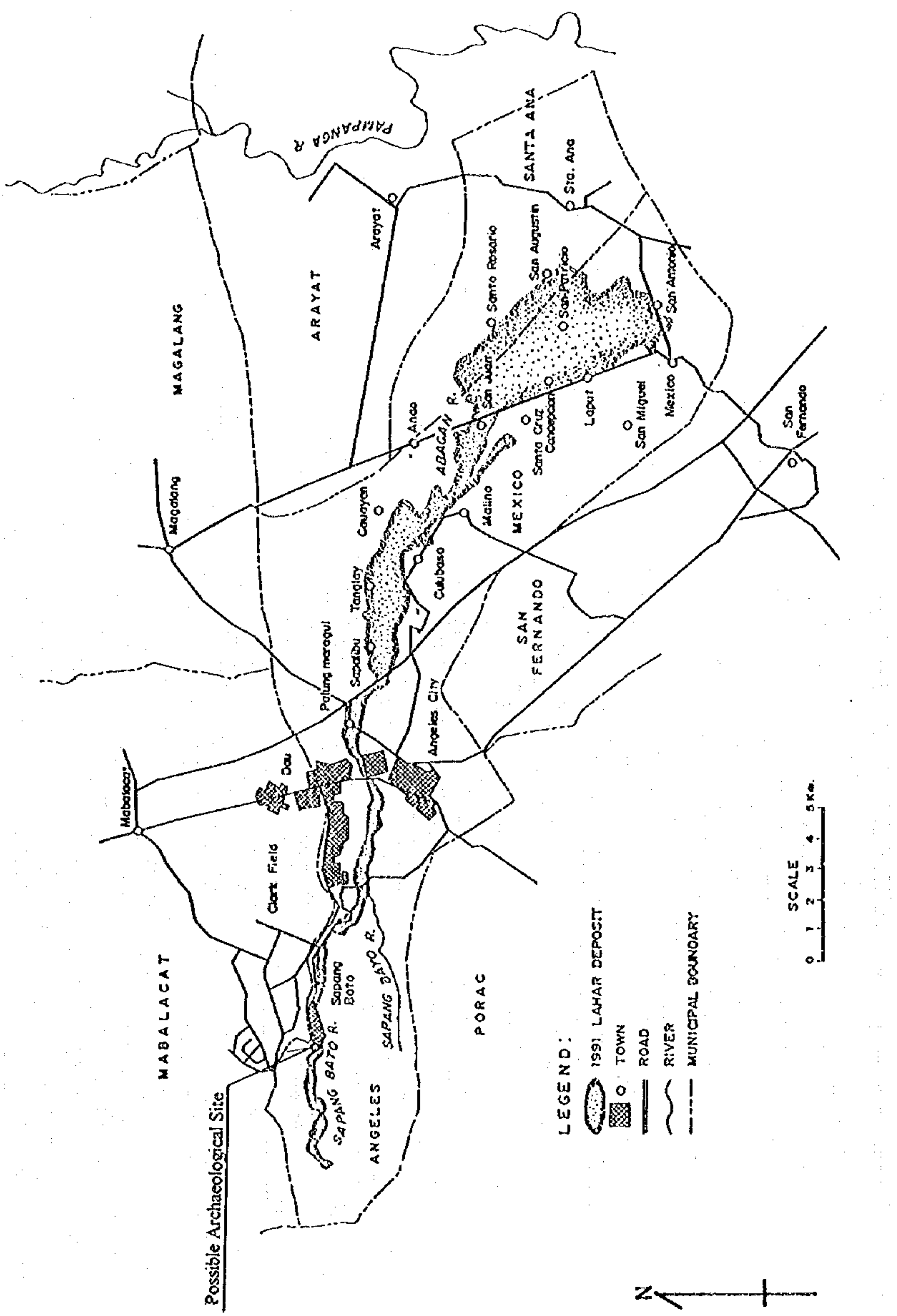

Figure P.4

Archaeological Site in the Study Area

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

THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO

JAPAN INTERNATIONAL COOPERATION AGENCY

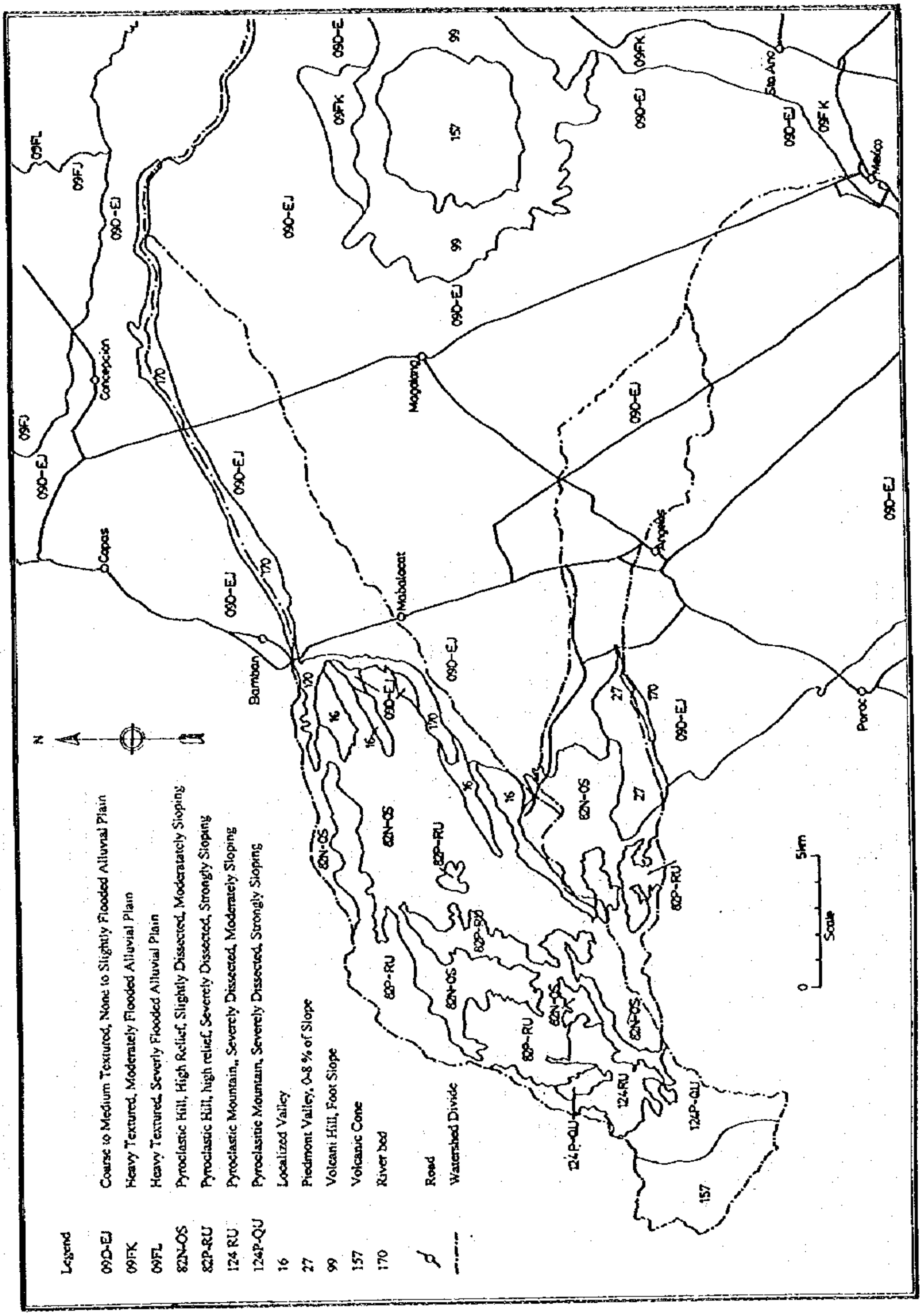

Figure P.5

Pre-eruption Land Management Units in the Study Area

THE GOVERNMENT OF THE PHILIPPINES   THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
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