社会開発調査部報告書

No. 52

JAPAN INTERNATIONAL COOPERATION AGENCY

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

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

APPENDIX I

MASTER PLAN STUDY

May 1996

NIPPON KOEI Co., Ltd., Tokyo Japan
in association with
CTI ENGINEERING Co., Ltd., Tokyo Japan

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Remarks : The cost estimate in this Study was based on the November 1995 price level, and expressed in Philippine Pesos equivalent according to the exchange rate Philippine Peso 25.0 = Japanese Yen 100.0 (= US dollars 1.0) prevailing at that time.

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SOCIO - ECONOMY

APPENDIX A

SOCIO-ECONOMY

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A.1 SOCIO-ECONOMY

1.1 POPULATION AND HOUSEHOLD SURVEY

A population survey covering the whole Study Area was conducted by JICA Study Team through the collaboration of a Filipino consulting firm, Development Partners Inc. The survey was conducted from August 10 to September 15,1994.

The survey was carried out through an actual counting and a sampling survey according to the three groups of the areas categorized as follows:

1) Affected areas: actual counting
2) Threatened areas: 5% sampling survey
3) Unaffected areas: 5% sampling survey

The definition of the above three area-group is :

1) "Affected areas" refer to those barangays which were affected by 1991 and 1992 lahar incidence and have programs to be resettled,
2) "Threatened areas" refer to those barangays which were also affected by 1991 and 1992 lahar incidence but have no programs to be resettled, and
3) "Unaffected areas" refer to those barangays which are situated in the Study Area and were not affected by lahar in the past.

The magnitude of the damages suffered by lahar and flood was deemed to have been enhanced by this order. The areal distinction among barangays of these three groups is shown in Fig.5.2.1 of Main Report.

The result of the population survey is shown by each barangay in Table A.1.1. The total household population of the Study Area is estimated at about 680,800 and the average family size was 5.1 in August 1994. The population density by each barangay is depicted in Figure 5.2.2 of Main Report.

No information was gathered from two barangays: Laput in Mexico municipality and Calumpang in Mabalacat municipality by the following reasons: a) refusal of the survey by barangay officials in Laput and b) complete isolation of Calumpang due to lahar sediment.

A.2 PROJECT EVALUATION

2.1 DEFINITION OF PROJECT BENEFIT

The benefit to be accrued from the implementation of the Project was defined in this Study as the reduction of direct and indirect damages to be caused by the flood/mudflow. The probable direct and indirect damages were estimated under the without-project conditions as of the end of 1994. The damage to be occurred under the with-project conditions were assumed to be zero under the design flood of less than 20-year return period. Thus, the project benefit constitutes the probable damage to be occurred by flood/mudflow of less than 20-year return period.

2.2 METHODOLOGY OF FLOOD DAMAGE ESTIMATE

(1) Estimate of Direct Damage

In estimating the damageable value of properties in the probable inundation area, a "Barangay Data Base" was established in the GIS (Geophysical Information System). All the data required for the estimate of damage including the area, farm land by crops,

population, number of household, number of buildings and establishments, infrastructures like roads and bridges, and irrigation canals of each barangay were input and arranged in this Data Base. An abstract of the said data base is compiled in Tables A.2.21 to A.2.22 for the probable inundation area of the Sacobia/Bamban and Abacan Rivers. (c.f. Appendix R for the details of GIS related matters.

The probable inundation areas were delineated for the two river basins on the basis of a hydrological simulation study and is shown in Figure A.2.1 for each return period of 2, 5, 10, 20, 50 and 100 years. The whole area of a barangay was divided into a number of cells of a 100-square meter in each of which the information on depths of inundation and sediment for each return period was loaded from flood analysis.

Damage curves were generated for major items of properties such as residential buildings, non-residential buildings, paddy field, upland crops, and infrastructures including roads and bridges. Damage curves were generated for each hazard of flooding, sediment and lahar toward the depth of each hazard. The damage curves established in the Study of Agno River Flood Control conducted by JICA in 1990 and the standard of Ministry of Construction of Japan were referred to in generating these curves. The said curves are depicted in Figure A.2.2.

The unit value of each damageable property was adopted mainly from the above-mentioned Agno Study after adjusting the change in market prices between the time of the two studies. The information derived from local government agencies were also incorporated. Unit values applied in this Study are shown in Table A.2.1.

The method of identifying and estimating damageable values is stated by each item hereunder:

1) Buildings

A regression formula showing the relationship between the number of house, establishments and household were generated through a multi-variable regression analysis for each barangay. The basic data were provided from the aerial photographs of probable inundation areas along the Bamban River in both the pre-eruption time and post-eruption time. The result of the population census in 1990 conducted by NSO and the result of the population survey conducted by the JICA Study Team in August 1994 were referred to as well. The recent result of the Survey of Establishment conducted by NSO in 1993 was also utilized. The regression formula obtained is shown in Table A.2.2. It was tried to establish two formulas for urban and rural areas respectively. But, due to the lack of data, only the formula for rural area in the Sacobia/Bamban River Basin could be derived and was applied commonly to urban area and Abacan River Basin as well. The number of buildings to be affected was obtained by this regression formula through inputting the percentage share of the affected area toward the barangay area of each barangay. The unit value of buildings are as shown in Table A.2.1 in which the depreciation ratio of 50% was assumed.

2) Agricultural Crops

The land use map of each agricultural crop was input into GIS Barangay Data Base for each barangay. This land use map was produced based on the Study of Dominant Land Use in the CLDP Study and the Key production Area map prepared by BSWM (Bureau of Soils and Water Management). The damage of agricultural crops were computed according to the area affected by the flood/mudflow of each return period. Unit prices applied were those net income values of each cop adopted in Agno Study after being adjusted for the price change between the time of the two studies. The said unit prices are shown in Table A.2.1. The damage of the livestock was estimated by a ratio (7%) of the

agricultural crops following the Agno Study after reviewed based on recent statistics.

3) Infrastructures

The length of roads and bridges were stored in the Barangay Data Base for each barangay. The damage to these infrastructures were computed according to the area to be affected in each barangay.

The probable damage was derived for each return period as the product of the above-mentioned area to be affected, depths of flood/mudflow, unit values and the number of properties.

The average annual direct damage was obtained for each river after aggregating each property damage and is tabulated in Tables A.2.3 and A.2.4. Judging from the gradient of the curves shown under the above-mentioned tables, the design period of 20 years can be said reasonable.

The probable direct damage by major properties and by each return period for each barangay is shown in Table A.2.23 for Sacobia/Bamban and in Table A.2.24 for Abacan River. The probable damage of the 20-year return period or each barangay is shown in Figure A.2.4 for Sacobia/Bamban River and in Figure A.2.5 for Abacan River.

(2) Estimate of Indirect Damage

In this Study, the indirect damage covers such secondary damages to be stemmed from the flood/mudflow occurrences as the additional transportation cost, the opportunity loss of product due to the interruption of economic activities caused by flood/mudflow, the cost of evacuation and the cost of clean-up of buildings. The indirect damages were estimated as stated hereunder.

1) Additional Transportation Cost

The probable additional cost of transportation due to the forced detour caused by flooding of roads and bridges was computed based on the detour distance, duration and the vehicle operation cost. The total traffic demand for crossing the Bamban River was assumed at 13,000 per day based on the recent traffic survey of JICA and DPWH. Some traffic surveys on the related road section are presented in Table A.2.5 and the traffic counting survey conducted by DPWH in November 1994 is shown in Table A.2.6.

The detour alternative routes were assumed for each origin-destination route under the normal condition, i.e., under the pre-eruption conditions as shown in Figure A.2.3. In determining the detour routes, it was assumed that the San Francisco Bridge on Route 329 is nor passable for one month time in the rainy season due to the flooding of its access road. During that time, the traffics bound for northern wards from San Fernando and Angeles were assumed to make a long detour taking the Friendship Highway via Santa Rita near Malolos without taking the shorter route via San Fernando-Gapan road to avoid the habitual flood prone area near around Mexico municipality.

The computation formula and other data for the computation is shown in Table A.2.7 and the details of the computation is shown in Table A.2.8. The time value of drivers were not included in this Study.

2) Loss of Production by Interruption of Economic Activities

The loss of production by the interruption of economic activities caused by flood/mudflows were estimated based on the per capita GRDP of non-agricultural sector (estimated at ₱36,900 in 1996 at 1994 price) multiplied by the duration and the number of affected people in urban areas. The computation of the estimated loss of GDP is shown in Table A.2.9.

3) Evacuation and Building Clean-Up Costs

The evacuation cost and the clean-up cost of building to be occurred at the time of disasters were estimated based on the unit cost from historical statistics as shown in Table A.2.1.

The duration of evacuation was assumed at 10 week for lahar and 1 week for flood. The period required for clean-up of buildings was assumed at 6 days for lahar and 3 days for flood. The average annual costs of evacuation and building clean-up for each return period are shown in Tables A.2.10 and A.2.11 for the two river basins respectively.

2.3 PROJECT COST

The construction cost of alternative schemes was estimated on the basis of the following preconditions:

1) the base period of cost estimate was set at the end of 1994
2) the exchange rates were assumed at US$1 = ₱ 25 = ¥100
3) the estimate excludes tax and duties
4) the estimate does not include the price contingency for the future
5) the physical contingency cost, administration cost and engineering services cost were estimated at 25% of the main construction cost.

The reclamation cost of the sand pocket is not included in any alternative schemes because the cultivation of the lahar affected farm land is not deemed feasible at the present stage of the Study yet. The cost for desilting works were treated as the maintenance cost and scheduled to be disbursed in four (4) years for Abacan and for nine (9) years for Sacobia/Bamban rivers starting from the initiation of the construction.

The operation and maintenance costs of each alternatives were estimated at 0.5% of the total construction cost.

The cost (financial) of all alternative schemes are summarized in Tables A.2.12 and A.2.13 for Sacobia/Bamban and Abacan Rivers, respectively.

2.4 BENEFIT-COST ANALYSIS

The financial cost shown in Tables A.2.12 and A.2.13 was converted into the economic cost to adjust the distorted market price value. Considering the current unemployment situation, the market wage was adjusted by shadow wage rate which was assumed at 60% of the market wage rate. In order to adjust the distortion of the official exchange rate, the standard conversion factor of 0.86 was applied following the recent practice of ADB (Asian Development Bank). The compensation of the land acquisition was adjusted through evaluating the land value by the production foregone value assuming the cultivation of the irrigated paddy (c.f. Table A.2.14).

The cost-benefit comparison is presented in Tables A.2.15 to A.2.19.

The disbursement of the capital investment was assumed evenly during four years of construction period. The desilting works were assumed to start from the beginning of the construction.

Benefits were assumed to accrue immediately after the completion of the Project. When the expected rapid economic growth in the Central Luzon Region is considered, the value of properties in the Study Area is reasonably expected to increase rapidly as well. In this Study, the flood control benefit, i.e., the saving of direct and indirect damages was assumed to increase at the same rate as that of GRDP of the Region, i.e., 8.23% p.a.

The benefit accrued from the saving of detour costs of vehicles is also expected to increase as the traffic volume increases. In this Study, the growth rate estimated for the new North Luzon Expressway studied by JICA in the LISR Study was adopted and 1.9% p.a. growth of traffics were applied. While, assuming the completion of the said new highway after 15 years, the transportation benefit was treated to be excluded from the project benefit. Among the four alternatives for the Sacobia/Bamban Rivers, the Alternative-1 does not include the construction of the road dike of the Route No. 3. This is the reason for the Alternative-1 to have less benefit than the other alternatives.

The result of the EIRR computation shows that only the Sacobia/Bamban Alternative-3 was justified. Among four alternative for the Sacobia/Bamban River, the Alternative-2 showed the highest EIRR of 14.6% followed by the Alternative-4 with a slight difference. The Abacan scheme showed a high EIRR of 28.2%.

2.5 IMPLICATION OF ECONOMIC EVALUATION

(1) "Present Status"

It is to be noted that the project benefit to be accrued from the saving of the probable direct damage was computed on the basis of the present (as of end 1994) conditions of the Study Area which is being covered partially by lahar deposit. Therefore, in such an area as Bamban municipality where a wide lahar deposit exists, the probable damage counted in the economic analysis is far less than that to be occurred under the pre-eruption conditions. In other words, there are less probable damage remaining in such a heavily damaged area, which worked to reduce the EIRR of the Project.

(2) Evaluation of Abacan Scheme

The high EIRR (28.2%) of the Abacan Scheme was derived mainly from the saving of probable building damages to be occurred in the probable inundation area which includes some densely populated areas in Angeles, Mexico and Sta. Ana. Even in some less populated barangays, a comparatively large damages are anticipated due to the probable damage ratio that is computed based on the duration of flooding (c.f. Figure A.2.5). The comparatively small amount of the construction cost is another reason of the high EIRR.

(3) Evaluation of Sacobia/Bamban Alternatives

The Alternative-2 (14.6%) has a slight advantage comparing with the Alternative-4 (14.4%) in terms of EIRR value. A major difference in structural components between these two alternatives is that the Alternative-4 has the component of the construction of a series of bed girdles in the Bamban River while the Alternative-2 does not have the component. The resulted EIRR shows that the construction of a series of bed girdles in the Bamban River would work to reduce the EIRR, though the Alternative-4 itself can be justified as a whole.

The benefit to be accrued from the saving of probable direct damages constitutes more than half of the total project benefit (c.f. Table A.2.16). Like the case of the Abacan, the component of building damage constitutes the major portion of the total benefit (c.f. Table

A.2.4). This is resulted from the fact that some densely populated areas in Concepcion municipality are included in the probable inundation area. In the less populated areas, the agricultural crops is anticipated to be the dominant damage in Concepcion. In Bamban municipality, no more large damages are anticipated after the heavy damages experienced in the past (c.f. Figure A.2.4).

The transportation benefit - savings of the detour cost of vehicle caused by the flooding of roads - occupies more than 40% of the total benefit. This shows the fact that the Study Area constitutes an important location in terms of the transportation connecting the National Capital Region and the Northern Luzon Regions. The transportation of raw materials and final products transported into and out-of San Fernando and/or Angeles constitutes the major flow of the traffic.

(4) Reclamation of Sand-Pocket

The pre-eruption conditions of the current sand-pocket area is shown below:

Name of Bgy.	Telabanca	Malonzo	Sto. Rosario	Sapang Balen	Tabun
Area (sq.km)	7.7	2.4	1.7	7.9	1.7
H/H (1990)	350	128	379	60	528
Pop. (1990)	2,249	811	2,268	347	3,001

The total area of about 22 square km land is now abandoned and utilized as the sand trap. As shown above, there existed in this area five (5) barangays before the eruption and the population was about 8,700 (1,450 households) in total of the whole barangays.

In this Study, the reclamation of the sand-pocket area was not included as a component. Because, the feasibility of the lahar cultivation was obscure. Assuming the sugarcane cultivation which is most profitable among various crops and assuming the normal yield of 45 ton/ha,

Net Income = ₱20,930 * 2,200 ha = ₱46 million/year
Reclamation Cost (Annualized) = ₱68.7 million (for 2,200 ha)

The simple comparison of annual cost and benefit suggests that the exclusion of the component is better for the Project. It seems better for the Project to implement the reclamation when an appropriate technology of the lahar cultivation is established and the lahar farming becomes feasible for farmers. Meanwhile, the present Project can prepare the conditions for a possible use of the sand-pocket area for farming. The area will be ready for farmers to cultivate with their own will and investment for the cultivation.

(5) Tourism Development

Apart from the structural measures to cope with possible natural disasters, the present Project will pave a way for the region to promote a possible tourism development in this area. Actually, a small natural lake has been created after the eruption in the upper stream of the Sapang Cauayan River in a walking distance from the Route No. 3. When the safety of the climbing Mt. Pinatubo is assured, then a volcano tourism with a sight-seeing network linking the mountains and lakes will become popular in this area. In the CLDP Study of JICA, the development of a sort of eco-tourism is being envisaged in the Region. An amusement park in Clark Field is also proposed in the same Study. A golf course is under construction near Dolores in Mabalacat municipality. All these tourism development plans can be realized only after the security against possible natural disasters is assured by such a structural measures proposed by the present Project.

(6) Physical Benefits

The Project benefit was estimated by the saving of probable direct and indirect damages caused by the probable flood and/or lahar with a scale of 20-year return period. The consequent physical benefit will extend to the following:

1) Population to be relieved from inundation : 53,000 (8% of Study Area)
2) Number of household to be relieved : 10,000 (7%)
3) Land area to be saved from inundation : 87 square km (8%)
4) Farm land to be saved : 4,300 ha

In summing up, the Project, as a whole of Abacan and Sacobia/Bamban Schemes, will relieve 53,000 persons of 10,000 households from suffering the inundation and will also save 87 square km of land in which 4,300 h is a farm land (c.f. Table A.2.20.).

The road traffic will be possible to be maintained the normal order, which is absolutely necessary for economic activities and also for the daily life of an ordinary people. With a security of the safety from the natural disasters, a company can make an investment with a longer time span. The most valuable benefit of the Project seems to be that many people can be free from the risk of losing their lives though it is not included in the benefit computation.

TABLES

Table A.1.1 Barangay Population of the Study Area in 1980, 1990 and 1994 (1/9)

Barangay Code	Province / Municipality / Barangay		Area (sq. km)	Population Census 1980 Number of Household	Population Census 1980 Population	Population Census 1990 Number of Household	Population Census 1990 Population	Population Survey August 1994 Number of Household	Population Survey August 1994 Population	Density (per sq.km) 1994	Growth Rate (% p.a.) 80 - 90	Growth Rate (% p.a.) 90 - 94
I.	Pampanga Province											
(1)	Angeles City	(33/33)										
2009001	A. DEL ROSARIO	(u)	1.00	825	4687	756	3894	760	2840	2840	-1.84	-7.59
2009002	AMSIC	(u)	2.39	-	-	704	3628	720	3580	1498	-	-0.33
2009003	ANUNAS	(u)	9.49	724	3424	1168	5939	1100	6180	651	5.66	1.00
2009004	BALIBAGO	(u)	2.63	5382	24328	6500	29791	5600	27880	10601	2.05	-1.64
2009005	CAPAYA	(u)	1.66	394	2475	769	4392	815	4095	2467	5.90	-1.74
2009006	CLARO M. RECTO	(u)	1.87	1395	7704	1317	6453	1220	6220	3326	-1.76	-0.92
2009007	CUAYAN		9.11	45	315	179	920	200	1080	119	11.31	4.09
2009008	CUTCUT	(u)	1.46	2113	12710	3579	17453	3260	16540	11329	3.22	-1.33
2009009	CUTUD		2.93	114	838	210	1290	240	1300	444	4.41	0.19
2009010	LOURDES NORTH WEST	(u)	0.53	1288	11361	2267	11534	2620	11980	22604	0.15	0.95
2009011	LOURDES SUR	(u)	0.22	1286	7589	1245	6519	1240	5800	26364	-1.51	-2.88
2009012	LOURDES SUR EAST	(u)	0.33	1181	7494	1166	6549	1200	5660	17152	-1.34	-3.58
2009013	MALABANIAS	(u)	0.93	2086	9972	3670	16050	2620	12140	13054	4.87	-6.74
2009014	MARGOT	(u)	1.35	261	1653	431	2452	460	2220	1644	4.02	-2.45
2009015	MINING		2.31	118	779	197	1122	200	780	338	3.72	-8.69
2009016	NINOY AQUINO (MARISOL)	(u)	1.17	-	-	2190	11898	2200	9700	8291	-	-4.98
2009017	PAMPANG	(u)	1.03	457	2848	1023	5727	1080	4920	4777	7.24	-3.73
2009018	PANDAN	(u)	0.97	2104	13301	1334	7565	1590	7992	8239	-5.49	1.38
2009019	PULONG CACUTUD	(u)	2.22	160	1070	316	1661	320	1440	649	4.62	-3.79
2009020	PULONG MARAGUL	(u)	1.52	795	4103	1859	8649	1660	8120	5342	7.74	-1.57
2009021	PULUNGBULU	(u)	3.49	1229	7463	1895	10295	2000	9300	2665	3.27	-2.51
2009022	SALAPUNGAN	(u)	2.09	1074	6104	1280	6649	998	5122	2451	0.86	-6.31
2009023	SAN JOSE	(u)	0.91	1066	6398	1283	6940	1300	6420	7055	0.82	-1.93
2009024	SAN NICOLAS	(u)	0.98	789	4379	713	3532	380	1420	1449	-2.13	-20.37
2009025	SANTO ROSARIO (POB.)	(u)	0.22	705	3930	734	4105	820	4000	18182	0.44	-0.65
2009026	SAPALIBUTAD		2.17	344	2131	481	2812	540	2900	1336	2.81	0.77
2009027	SAPANGBATO	(u)	21.80	1229	7430	1793	9477	1780	8200	376	2.46	-3.55
2009028	STA. TERESITA	(u)	0.56	1865	10795	2325	11690	2200	9360	16714	0.80	-5.41
2009029	STA. TRINIDAD	(u)	1.16	928	5552	1082	5887	1100	5460	4707	0.59	-1.86
2009030	STO. CRISTO	(u)	1.12	482	2793	720	3857	720	3140	2804	3.28	-5.01
2009031	STO. DOMINGO	(u)	2.22	2165	12595	2629	14869	2660	11560	5207	1.67	-6.10
2009032	TABUN		1.06	107	688	275	1515	258	1341	1265	8.21	-3.00
2009033	V. DELOS REMEDIOS	(u)	0.45	426	1925	331	1551	300	1260	2800	-2.14	-5.06
	ANGELES TOTAL (33)		83.35	33137	188834	46421	236685	44161	209950	2519	2.28	-2.95
	Urban Sub-Total (28)		65.77	32409	184083	45079	229026	42723	202549	3080	2.21	-3.02

Table A.1.1 Barangay Population of the Study Area in 1980, 1990 and 1994 (2/9)

Barangay Code	Province / Municipality / Barangay		Area (sq. km)	Population Census 1980 Number of Household	Population Census 1980 Population	Population Census 1990 Number of Household	Population Census 1990 Population	Population Survey August 1994 Number of Household	Population Survey August 1994 Population	Density (per sq.km) 1994	Growth Rate (% p.a.) 80 - 90	Growth Rate (% p.a.) 90 - 94
(2)	Arayat Municipality	(30/30)										
2012001	ARENAS		3.88	246	1599	317	1901	400	2520	649	1.75	7.30
2012002	BALITI		2.45	159	1011	220	1294	240	1220	499	2.50	-1.46
2012003	BATASAN		1.90	183	1122	235	1422	284	1613	850	2.40	3.20
2012004	BUENSUCESO		4.71	63	434	124	747	100	520	110	5.58	-8.66
2012005	CANDATING		6.14	377	2200	545	3052	625	3432	559	3.33	2.98
2012006	GATIAWIN		6.60	313	2101	487	3124	580	3700	561	4.05	4.32
2012007	GUEMASAN		0.72	303	1964	416	2501	580	3020	4178	2.45	4.83
2012008	KALEDIAN (CAMBA)		1.81		1968	449	2644	500	2920	1613	3.00	2.51
2012009	LA PAZ (TURU)		7.43	53	345	69	420	100	580	78	1.99	8.40
2012010	LACMIT		5.15	386	2521	535	3367	620	3440	668	2.94	0.54
2012011	LAQUIOUS		0.37	192	1267	260	1713	319	1781	4760	3.06	0.98
2012012	MANGA-CACUTUD	(u)	0.78	766	5141	1050	6475	1780	8840	11315	2.33	8.09
2012013	MAPALAD		14.22	236	1648	344	2099	337	2001	141	2.45	-1.19
2012014	PANLINLANG		7.99		1072	236	1491	280	1620	203	3.35	2.10
2012015	PARALAYA	(u)	0.36		1488	261	1427	220	920	2580	-0.42	-10.39
2012016	PLAZANG LUMA	(u)	1.97		3054	650	3847	780	4760	2419	2.34	5.47
2012017	POBLACION	(u)	0.33		2487	542	2917	402	1984	5934	1.61	-9.19
2012018	SAN AGUSTIN NORTE		0.74		1704	381	2333	440	2860	3858	3.19	5.22
2012019	SAN AGUSTIN SUR		0.38		928	184	1082	210	1079	2876	1.55	-0.07
2012020	SAN ANTONIO		5.23		1450	299	1722	340	1900	363	1.73	2.49
2012021	SAN JOSE MESULO		1.15		2790	591	3511	660	3720	3245	2.33	1.46
2012022	SAN JUAN BANO		8.98		3381	727	4459	840	4660	519	2.81	1.11
2012023	SAN MATEO		6.49		2659	534	3478	615	3550	547	2.72	0.51
2012024	SAN NICOLAS		1.34		3536	777	4702	480	2340	1751	2.89	-16.01
2012025	SAN ROQUE (BITAS)		9.36		1923	373	2555	480	3220	344	2.88	5.95
2012026	STA. LUCIA CUPANG		0.72		1505	350	2078	386	2165	3022	3.28	1.03
2012027	STA. LUCIA MATAMO		1.22		1624	334	1917	311	1698	1394	1.67	-2.99
2012028	STO. NINO TABUAN		10.64		1082	263	1693	310	1689	159	4.58	-0.06
2012029	SUCLAYIN		2.34		1360	304	1773	333	1941	828	2.69	2.29
2012030	TELAPAYUNG		4.03		1328	243	1445	326	1787	444	0.85	5.45
	Arayat Total (30)		119.42		56692	12100	73189	13878	77480	649	2.59	1.43
	Urban Sub-Total (4)		3.44		12170	2503	14666	3182	16504	4798	1.88	3.00

Table A.1.1 Barangay Population of the Study Area in 1980, 1990 and 1994 (3/9)

Barangay Code	Province / Municipality / Barangay		Area (sq. km)	Population Census 1980 Number of Household	Population Census 1980 Population	Population Census 1990 Number of Household	Population Census 1990 Population	Population Survey August 1994 Number of Household	Population Survey August 1994 Population	Density (per sq.km) 1994	Growth Rate (% p.a.) 80 - 90	Growth Rate (% p.a.) 90 - 94
(3)	Mabalacat Municipality	(28/28)										
2010001	ATLU BOLA		0.93	59	354	91	549	200	1060	1140	4.49	17.88
2010002	BICAL		2.54	127	840	207	1281	480	2380	937	4.31	16.75
2010003	BUNDAGUL		2.52	76	457	187	987	100	500	198	8.00	-15.63
2010004	CACUTUD		2.00	171	1118	248	1563	200	840	420	3.41	-14.38
2010005	CALUMPANG		36.57	44	251	76	431	76	431	12	5.56	0.00
2010006	CAMATCHILES		2.37	126	785	562	2915	600	2920	1232	14.02	0.04
2010007	DAPDAP		1.21	66	425	101	572	120	500	413	3.02	-3.31
2010008	DAU	(u)	1.25	5589	33152	9199	47180	10360	48940	39152	3.59	0.92
2010009	DOLORES	(u)	5.45	1014	6466	1471	8218	49	256	47	2.43	-57.99
2010010	DUQUIT		5.90	216	1231	789	4080	420	1940	329	12.73	-16.96
2010011	LAKANDULA	(u)	14.29	599	3454	1268	6524	1700	8620	603	6.57	7.21
2010012	MABIGA	(u)	1.42	598	3708	2116	10985	1940	9580	6746	11.47	-3.36
2010013	MACAPAGAL VILLAGE		6.16	143	808	227	1215	140	720	117	4.16	-12.26
2010014	MAMATITANG		2.01	224	1445	296	1662	233	1291	642	1.41	-6.12
2010015	MANGALIT		2.17	95	530	114	649	100	620	286	2.05	-1.14
2010016	MARCOS VILLAGE		5.37	231	1199	362	2031	100	500	93	5.41	-29.56
2010017	MAWAKE		2.57	62	431	99	549	80	520	202	2.45	-1.35
2010018	PARALAYUNAN		2.34	74	512	129	676	100	520	222	2.82	-6.35
2010019	POBLACION	(u)	0.07	395	2526	465	2552	300	1840	26286	0.10	-7.85
2010020	SAN FRANCISCO	(u)	1.42	1394	8596	1949	10432	2020	9280	6535	1.95	-2.88
2010021	SAN JOAQUIN	(u)	6.63	628	4248	843	4879	902	4402	664	1.39	-2.54
2010022	SAPANG BIABAS		3.41	48	300	102	570	200	1060	311	6.63	16.78
2010023	SAPANGBALEN		11.34	41	263	60	347	0	0	0	2.81	-100.00
2010024	STA. INES	(u)	2.78	504	3263	799	4479	780	3580	1288	3.22	-5.45
2010025	STA. MARIA		1.71	57	372	83	520	280	1420	830	3.41	28.55
2010026	STO. ROSARIO		1.48	325	2015	379	2268	400	2080	1405	1.19	-2.14
2010027	TABUN	(u)	5.62	338	2217	528	3001	0	0	0	3.07	-100.00
2010999	NOT NAMED		22.00									
	Mabalacat Total (28)		153.53	13244	80966	22750	121115	21880	105800	689	4.11	-3.32
	Urban Sub-Total (9)		38.93	11059	67630	18638	98250	18051	86498	2222	3.81	-3.13

Table A.1.1 Barangay Population of the Study Area in 1980, 1990 and 1994 (4/9)

Barangay Code	Province / Municipality / Barangay		Area (sq. km)	Population Census 1980 Number of Household	Population Census 1980 Population	Population Census 1990 Number of Household	Population Census 1990 Population	Population Survey August 1994 Number of Household	Population Survey August 1994 Population	Density (per sq.km) 1994	Growth Rate (% p.a.) 80 - 90	Growth Rate (% p.a.) 90 - 94
(4)	Magalang Municipality	(27/27)										
2011001	AYALA	(u)	0.60		-	315	1779	340	1680	3133	-	1.39
2011002	BUCANAN		1.62	95	694	166	947	180	860	531	3.16	-2.38
2011003	CAMIAS		3.56	97	656	126	782	140	760	213	1.77	-0.71
2011004	DOLORES		0.09	88	538	130	710	140	560	6222	2.81	-5.76
2011005	ESCALER		0.53	115	814	154	969	180	980	1849	1.76	0.28
2011006	LA PAZ		2.19	87	635	142	922	140	800	365	3.80	-3.49
2011007	NAVALING		4.26	100	660	138	854	163	985	231	2.61	3.63
2011008	SAN AGUSTIN		31.32	314	1906	216	1237	240	1500	48	-4.23	4.94
2011009	SAN ANTONIO		3.22	95	647	128	752	140	840	261	1.52	2.81
2011010	SAN FRANCISCO		2.28	252	1908	383	2337	440	2640	1158	2.05	3.09
2011011	SAN ILDEFONSO		5.56	555	3618	743	4563	820	5000	899	2.35	2.31
2011012	SAN ISIDRO		5.63	80	492	106	756	140	800	142	4.39	1.42
2011013	SAN JOSE		2.97	148	991	225	1311	240	1280	431	2.84	-0.60
2011014	SAN MIGUEL		1.94	133	964	196	1216	220	1240	639	2.35	0.49
2011015	SAN NICOLAS 1ST (POB.)	(u)	0.24	487	2935	485	2812	540	2300	9583	-0.43	-4.90
2011016	SAN NICOLAS 2ND	(u)	0.47	361	2403	493	2906	540	2660	5660	1.92	-2.19
2011017	SAN PABLO (POB.)	(u)	9.53	78	518	128	739	140	700	73	3.62	-1.35
2011018	SAN PEDRO I	(u)	0.82	242	1712	284	1748	320	1720	2098	0.21	-0.40
2011019	SAN PEDRO II	(u)	1.87	312	2130	427	2340	440	2220	1187	0.94	-1.31
2011020	SAN ROQUE		6.83	214	1348	296	1795	321	1879	275	2.91	1.15
2011021	SAN VICENTE		3.05	206	1350	300	1813	340	1780	584	2.99	-0.46
2011022	STA. CRUZ (POB.)	(u)	2.94	470	2973	672	3857	680	3860	1313	2.64	0.02
2011023	STA. LUCIA		3.98	40	243	65	352	60	440	111	3.78	5.74
2011024	STA. MARIA		5.77	171	1078	241	1428	260	1800	312	2.85	5.96
2011025	STO. NINO		1.06	154	1008	269	1626	300	1520	1434	4.90	-1.67
2011026	STO. ROSARIO		10.53	293	1994	433	2547	488	2690	255	2.48	1.37
2011027	TURU		25.49	91	625	128	842	140	896	35	3.03	1.57
	Magalang Total (27)		138.35	5278	34840	7389	43940	8092	44590	322	2.35	0.37
	Urban Sub-Total (7)		16.47	1950	12671	2804	16181	3000	15340	931	2.48	-1.33

Table A.1.1 Barangay Population of the Study Area in 1980, 1990 and 1994 (5/9)

Barangay Code	Province / Municipality / Barangay		Area (sq. km)	Population Census 1980 Number of Household	Population Census 1980 Population	Population Census 1990 Number of Household	Population Census 1990 Population	Population Survey August 1994 Number of Household	Population Survey August 1994 Population	Density (per sq.km) 1994	Growth Rate (% p.a.) 80 - 90	Growth Rate (% p.a.) 90 - 94
(5)	Mexico Municipality	(43/43)										
2021001	ACLI		3.25	1221	850	155	979	181	1088	335	1.42	2.67
2021002	ANAO		1.08	361	2338	505	2962	355	1972	1832	2.39	-9.67
2021003	BALAS		2.05	186	1170	274	1664	320	1420	693	3.58	-3.89
2021004	BUENAVISTA		3.96	84	559	120	753	137	911	230	3.02	4.88
2021005	CAMUNING		1.84	193	1270	234	1574	220	1374	748	2.17	-3.34
2021006	CAWAYAN		3.19	93	568	131	638	150	743	233	1.17	3.88
2021007	CONCEPCION		0.67	168	1063	240	1418	260	1400	2076	2.92	-0.32
2021008	CULUBASA		1.57	249	1716	353	2303	280	1693	1079	2.99	-7.40
2021009	DIVISORIA		2.20	121	758	172	1083	193	1125	512	3.63	0.96
2021010	DOLORES (PIRING)		2.68	110	738	165	1057	194	1222	456	3.66	3.69
2021011	EDEN		2.23	51	347	53	362	90	540	242	0.42	10.52
2021012	GANDUS		3.24	52	352	75	473	85	490	151	3.00	0.89
2021013	LAGUNDI	(u)	2.65	278	1827	415	2399	480	2340	883	2.76	-0.62
2021014	LAPUT		1.18	155	953	234	1451	234	1451	1231	4.29	0.00
2021015	LAUG		1.59	228	1520	289	1847	340	1980	1247	1.97	1.75
2021016	MASAMAT		2.58	90	568	129	728	140	620	240	2.51	-3.94
2021017	MASANGSANG	(u)	2.76	246	1725	342	2147	338	1797	651	2.21	-4.35
2021018	NUEVA VICTORIA		4.91	82	509	95	641	120	760	155	2.33	4.35
2021019	PANDACAQUI		5.30	153	1033	207	1286	260	1320	249	2.21	0.65
2021020	PANGATLAN		5.91	168	1085	208	1352	201	1281	217	2.22	-1.34
2021021	PANIPUAN		3.43	85	544	119	726	180	1100	321	2.93	10.95
2021022	PARIAN (POB.)	(u)	0.39	514	3448	665	4109	820	4680	12035	1.77	3.31
2021023	SABANILLA		1.23	136	922	183	1098	200	900	730	1.76	-4.85
2021024	SAN ANTONIO	(u)	0.28	426	3063	619	3916	740	4160	14835	2.49	1.52
2021025	SAN CARLOS	(u)	0.84	219	1520	341	2118	400	1974	2360	3.37	-1.74
2021026	SAN JOSE MALINO		2.40	391	2694	545	3522	585	3532	1474	2.72	0.07
2021027	SAN JOSE MATULID		2.22	205	1410	320	1958	360	2380	1073	3.34	5.00
2021028	SAN JUAN		1.01	284	1795	385	2464	458	2351	2331	3.22	-1.17
2021029	SAN LORENZO		0.83	210	1366	275	1693	320	2080	2510	2.17	5.28
2021030	SAN MIGUEL		1.79	114	790	189	1147	240	1390	770	3.80	4.73
2021031	SAN NICOLAS		1.13	171	1174	242	1465	167	926	820	2.24	-10.84
2021032	SAN PABLO		1.04	163	1071	220	1335	240	1360	1302	2.23	0.46
2021033	SAN PATRICIO		2.31	326	2183	454	2896	660	3800	1645	2.87	7.03
2021034	SAN RAFAEL		2.00	67	405	99	635	120	700	350	4.60	2.47
2021035	SAN ROQUE		1.54	66	433	104	647	120	660	428	4.10	0.50

Table A.1.1 Barangay Population of the Study Area in 1980, 1990 and 1994 (6/9)

Barangay Code	Province / Municipality / Barangay		Area (sq. km)	Population Census 1980 Number of Household	Population Census 1980 Population	Population Census 1990 Number of Household	Population Census 1990 Population	Population Survey August 1994 Number of Household	Population Survey August 1994 Population	Density (per sq.km) 1994	Growth Rate (% p.a.) 80 - 90	Growth Rate (% p.a.) 90 - 94
2021036	SAN VICENTE		2.20	291	1866	378	2429	425	2677	1218	2.67	2.46
2021037	SAPANG MAISAC		4.03	265	1712	420	2387	460	2560	635	3.38	1.76
2021038	STA. CRUZ		3.22	167	1060	201	1406	274	1569	488	2.87	2.78
2021039	STA. MARIA		1.74	171	1148	272	1597	355	1778	1025	3.36	2.72
2021040	STO. DOMINGO	(u)	1.85	182	1261	277	1617	255	1253	676	2.52	-6.18
2021041	STO. ROSARIO	(u)	3.28	258	1649	317	1870	400	2020	616	1.27	1.95
2021042	SUCLABAN		3.15	62	408	97	594	102	622	198	3.65	1.59
2021043	TANGLAY (TANGLE)		2.25	93	620	116	705	140	779	346	1.29	2.53
	Mexico Total (43)		98.97	9155	53491	11234	69441	12599	70768	715	2.64	0.47
	Urban Sub-Total (7)		12.05	2123	14493	2976	18176	3433	18224	1513	2.29	0.07
(6)	Sta. Ana Municipality	(14/14)										
2022001	SAN AGUSTIN		5.30	234	1299	271	1649	339	1931	364	2.41	4.03
2022002	SAN BARTOLOME		2.71	184	1056	233	1522	224	1242	458	3.72	-4.96
2022003	SAN ISIDRO		3.01	524	3300	690	4203	800	4780	1588	2.45	3.27
2022004	SAN JOAQUIN (POB.)	(u)	2.05	501	2632	445	2767	368	2198	1072	0.50	-5.59
2022005	SAN JOSE		1.46	116	610	128	737	300	1680	1151	1.91	22.87
2022006	SAN JUAN	(u)	1.49	207	1193	265	1569	259	1404	942	2.78	-2.74
2022007	SAN NICOLAS		1.36	346	2102	434	2639	520	2920	2147	2.30	2.56
2022008	SAN PABLO		3.96	351	2143	422	2737	580	3080	778	2.48	3.00
2022009	SAN PEDRO		1.66	118	714	160	939	160	1047	631	2.78	2.76
2022010	SAN ROQUE		5.30	297	1637	368	2337	393	2412	455	3.62	0.79
2022011	SANTA MARIA		2.37	549	3056	617	3819	740	4200	1772	2.25	2.41
2022012	SANTIAGO		3.12	386	2188	418	2757	471	2647	848	2.34	-1.01
2022013	SANTO ROSARIO		4.05	136	784	154	977	113	663	164	2.23	-9.24
2022014	STA. LUCIA		6.50	458	2647	645	3888	680	3460	532	3.92	-2.87
	Sta.Ana Total (14)		44.34	4407	25361	5250	32540	5947	33664	759	2.52	0.85
	Urban Sub-Total (2)		3.54	708	3825	710	4336	627	3602	1018	1.26	-4.53
	PAMPANGA TOTAL (175)		637.96	65221	440184	105144	576910	106557	542252	850	2.74	-1.54
	Pampanga Urban Total (57)		140.20	48249	294872	72710	380635	71016	342717	2445	2.59	-2.59

Table A.1.1 Barangay Population of the Study Area in 1980, 1990 and 1994 (7/9)

Barangay Code	Province / Municipality / Barangay		Area (sq. km)	Population Census 1980 Number of Household	Population Census 1980 Population	Population Census 1990 Number of Household	Population Census 1990 Population	Population Survey August 1994 Number of Household	Population Survey August 1994 Population	Density (per sq.km) 1994	Growth Rate (% p.a.) 80 - 90	Growth Rate (% p.a.) 90 - 94
II.	Tarlac Province											
(1)	Bamban Municipality	(15/15)										
2317001	ANUPUL		130.60	538	3447	887	5035	1239	6017	46	3.86	4.56
2317002	BANABA	(u)	0.16	624	4095	964	5695	220	820	5125	3.35	-38.40
2317003	BANGCU		1.36	26	164	35	216	0	0	0	2.79	-100.00
2317004	CULUBASA		0.12	25	162	49	271	3	17	142	5.28	-49.95
2317005	DELA CRUZ	(u)	0.93	505	2039	456	2613	166	820	882	2.51	-25.15
2317006	LA PAZ	(u)	0.94	37	2378	396	2312	123	602	640	-0.28	-28.57
2317007	LOURDES	(u)	0.26	557	3464	881	5033	163	765	2942	3.81	-37.56
2317008	MALONZO		1.62	110	637	128	811	0	0	0	2.44	-100.00
2317009	PACALCAL		1.70	131	845	194	1126	128	666	392	2.91	-12.30
2317010	SAN NICOLAS (POB.)	(u)	0.36	617	4039	965	5499	1140	5780	16056	3.13	1.25
2317011	SAN PEDRO		1.64	215	1408	365	2069	0	0	0	3.92	-100.00
2317012	SAN RAFAEL		0.57	51	383	110	684	123	678	1189	5.97	-0.22
2317013	SAN ROQUE	(u)	0.48	291	1823	366	2088	140	641	1335	1.37	-25.56
2317014	SAN VICENTE		1.10	107	594	218	1201	120	534	485	7.29	-18.34
2317015	STO. NINO		1.30	138	594	195	986	150	668	514	5.20	-9.28
	Bamban Total (15)		143.14	3972	26072	6209	35639	3715	18008	126	3.18	-15.69
	Urban Sub-Total (6)		3.13	2631	17838	4028	23240	1952	9428	3012	2.68	-20.19
(2)	Capas Municipality	(8/19)										
2315001	ARANGUREN		4.83	548	3357	784	4385	820	3600	745	2.71	-4.81
2315003	CUBCUB (POB.)	(u)	1.74	362	2178	469	2611	416	2119	1218	1.83	-5.09
2315004	CUTCUT 1ST	(u)	1.46	550	3594	980	5650	887	4550	3116	4.63	-5.27
2315005	CUTCUT 2ND	(u)	0.97	393	2468	554	3177	300	1528	1575	2.56	-16.72
2315011	MARUGLU		2.45	91	492	201	1084	200	1340	547	8.22	5.44
2315016	STO. DOMINGO 1ST	(u)	2.59	259	1684	337	1948	268	1192	460	1.47	-11.56
2315017	STO. DOMINGO 2ND	(u)	5.94	464	2834	691	4016	555	2740	461	3.55	-9.12
2315018	STO. ROSARIO		41.02	386	2276	523	2924	590	2918	71	2.54	-0.05
	Capas Total (8)		61.00	3053	18883	4539	25795	4036	19987	328	3.17	-6.18
	Urban Sub-Total (5)		12.70	2028	12758	3031	17402	2426	12129	955	3.15	-8.63

Table A.1.1 Barangay Population of the Study Area in 1980, 1990 and 1994 (8/9)

Barangay Code	Province / Municipality / Barangay		Area (sq. km)	Population Census 1980 Number of Household	Population Census 1980 Population	Population Census 1990 Number of Household	Population Census 1990 Population	Population Survey August 1994 Number of Household	Population Survey August 1994 Population	Density (per sq.km) 1994	Growth Rate (% p.a.) 80 - 90	Growth Rate (% p.a.) 90 - 94
(3)	Concepcion Municipality	(43/45)										
2316001	ALFONSO		1.96	710	4225	797	4740	763	3910	1995	1.16	-4.70
2316002	BALUTU		2.08	435	2468	495	2943	700	4380	2106	1.78	10.45
2316003	CAFE		8.05	306	1766	397	2277	365	1983	246	2.57	-3.40
2316004	CALIUS GUECO		0.58	101	699	148	904	240	1320	2276	2.61	9.93
2316005	CALULUAN		2.90	399	2393	543	3206	720	3860	1331	2.97	4.75
2316006	CASTILLO		17.58	239	1508	352	2155	420	2180	124	3.63	0.29
2316007	CORAZON DE JESUS		2.97	177	1155	256	1523	204	1012	341	2.80	-9.71
2316008	CULATINGAN		6.23	299	1842	392	2509	399	2229	358	3.14	-2.91
2316009	DUNGAN		7.65	81	502	125	713	130	673	88	3.57	-1.43
2316010	DUTUNG-A-MATAS		2.99	185	1138	261	1538	512	2683	897	3.06	14.93
2316011	GREEN VILLAGE		0.90	-	-	271	1611	277	1395	1550	-	-3.54
2316012	ULIBANGAN		8.91	87	559	127	785	140	700	79	3.45	-2.82
2316013	MABILOG		7.96	249	1404	301	1728	364	1691	212	2.10	-0.54
2316014	MAGAO		4.00	261	1710	374	2431	460	2740	685	3.58	3.04
2316015	MALUPA		2.14	143	979	230	1463	280	1460	682	4.10	-0.05
2316016	MINANE		2.82	512	3166	574	3550	720	4420	1567	1.15	5.63
2316017	PANALICSICAN		9.58	124	819	146	894	240	1240	129	0.88	8.52
2316018	PANDO		5.21	208	1194	280	1546	440	2280	438	2.62	10.20
2316020	PARULUNG		2.87	130	834	172	1004	182	989	345	1.87	-0.38
2316021	PITABUNAN		3.53	164	935	181	1152	222	1078	305	2.11	-1.65
2316023	SAN ANTONIO		4.54	255	1559	329	1998	520	3380	744	2.51	14.05
2316024	SAN BARTOLOME		5.01	185	1207	261	1634	360	2040	407	3.08	5.70
2316025	SAN FRANCISCO		3.06	514	3532	718	4374	942	4839	1581	2.16	2.56
2316026	SAN ISIDRO (ALMENDRAS)		7.79	302	1848	347	2139	480	2560	329	1.47	4.59
2316027	SAN JOSE (POB.)	(u)	0.67	1061	6535	1267	7591	1195	6248	9325	1.51	-4.75
2316028	SAN JUAN (CASTRO)		2.66	231	1409	323	1986	720	4320	1624	3.49	21.44
2316029	SAN MARTIN		3.66	131	934	178	1220	240	1000	273	2.71	-4.85
2316030	SAN NICOLAS (POB.)	(u)	0.99	666	3798	700	3891	591	2797	2825	0.24	-7.92
2316031	SAN NICOLAS BALAS		6.08	245	1680	328	2046	480	2860	470	1.99	8.73
2316032	SAN VICENTE		3.26	110	703	164	1049	240	1340	411	4.08	6.31
2316033	SANTIAGO		2.93	376	2471	484	3113	459	2482	847	2.34	-5.51
2316034	STA. CRUZ		3.86	383	2428	531	3309	547	3109	805	3.14	-1.55
2316035	STA. MARIA		0.54	81	485	109	649	119	567	1050	2.96	-3.32
2316036	STA. MONICA		7.13	555	3366	688	4231	747	3980	558	2.31	-1.52
2316037	STA. RITA		3.09	665	4172	876	4885	960	4080	1320	1.59	-4.40

Table A.1.1 Barangay Population of the Study Area in 1980, 1990 and 1994 (9/9)

Barangay Code	Province / Municipality / Barangay	Area (sq. km)	Population Census 1980 Number of Household	Population Census 1980 Population	Population Census 1990 Number of Household	Population Census 1990 Population	Population Survey August 1994 Number of Household	Population Survey August 1994 Population	Density (per sq.km) 1994	Growth Rate (% p.a.) 80 - 90	Growth Rate (% p.a.) 90 - 94
2316038	STA. ROSA	3.34	274	1754	502	3012	494	2523	755	5.56	-4.33
2316039	STO. CRISTO	0.54	105	737	144	879	240	1000	1852	1.78	3.28
2316040	STO. NINO	4.21	204	1265	295	1766	356	1808	429	3.39	0.59
2316041	STO. ROSARIO (MAGUNTING)	0.97	148	906	195	1269	236	1186	1223	3.43	-1.68
2316042	TALIMUNDUC MARIMLA	4.06	156	991	170	1112	223	1231	303	1.16	2.57
2316043	TALIMUNDUC SAN MIGUEL	5.44	188	1287	284	1713	240	1160	213	2.90	-9.29
2316044	TELABANCA	9.32	270	1795	350	2249	174	946	102	2.28	-19.47
2316045	TINANG	9.29	381	2288	497	2989	559	2866	309	2.71	-1.05
	Concepcion Total (43)	193.35	12296	76446	16162	97776	18900	100545	520	2.49	0.70
	Urban Sub-Total (2)	1.66	1727	10333	1967	11482	1786	9045	5449	1.06	-5.79
	TARLAC TOTAL (66)	397.49	19321	121401	26910	159210	26651	138540	349	2.75	-3.42
	Tarlac Urban Total (13)	17.49	6386	40929	9026	52124	6164	30602	1750	2.45	-12.47
	URBAN GRAND TOTAL (70)	157.69	54635	335801	81736	432759	77180	373319	2367	2.57	-3.63
	GRAND TOTAL (241)	1035.45	84542	561585	132054	736120	133208	680792	657	2.74	-1.93

Source: 1) NSO Census of Population and Household in 1980 and 1990.
2) Population Survey by JICA Study Team in August 1994.

Note: 1) The barangay area was adopted from the GIS data of NEDA Region 3 except for the two barangays of San Vicente and Sto. Nino in Bamban Municipality whose area were measured on the map.
2) The number in the parenthesis after the municipality name shows that of the objective barangays toward total barangays.
3) The classification of "urban" which is shown by (u) after the name of the barangay and "rural" barangays was made according to the Socio-economic Profile of each Municipality.
4) The population in August 1994 of the two barangays, Calumpang in Mabalacat and Laput in Mexico, was assumed to be the same as those of 1990. Because the survey was not able to be conducted by the failure of obtaining the consent of the barangays.
5) An area with nor barangay name and nor inhabitant is included in Mabalacat Municipality.

Table A.1.2 Municipality Population of the Study Area in 1980, 1990 and 1994

Municipality/City	Area (sq. km)	Population Census 1980 Number of Household	Population Census 1980 Population	Population Census 1990 Number of Household	Population Census 1990 Population	Population Survey August 1994 Number of Household	Population Survey August 1994 Population	Density (per sq.km) 1994	Growth Rate (% p.a.) 80 - 90	Growth Rate (% p.a.) 90 - 94	Number of family per Household 1980	Number of family per Household 1990	Number of family per Household 1994
ANGELES TOTAL (33)	83.35	33137	188834	46421	236685	44161	209950	2519	2.28	-2.95	5.70	5.10	4.75
Urban Sub-Total (28)	65.77	32409	184083	45079	229026	42723	202549	3080	2.21	-3.02	5.68	5.08	4.74
Arayat Total (30)	119.42		56692	12100	73189	13878	77480	649	2.59	1.43	#DIV/0!	6.05	5.58
Urban Sub-Total (4)	3.44		12170	2503	14666	3182	16504	4798	1.88	3.00	#DIV/0!	5.86	5.19
Mabalacat Total (28)	153.53	13244	80966	22750	121115	21880	105800	689	4.11	-3.32	6.11	5.32	4.84
Urban Sub-Total (9)	38.93	11059	67630	18638	98250	18051	86498	2222	3.81	-3.13	6.12	5.27	4.79
Magalang Total (27)	138.35	5278	34840	7389	43940	8092	44590	322	2.35	0.37	6.60	5.95	5.51
Urban Sub-Total (7)	16.47	1950	12671	2804	16181	3000	15340	931	2.48	-1.33	6.50	5.77	5.11
Mexico Total (43)	98.97	9155	53491	11234	69441	12599	70768	715	2.64	0.47	5.84	6.18	5.62
Urban Sub-Total (7)	12.05	2123	14493	2976	18176	3433	18224	1513	2.29	0.07	6.83	6.11	5.31
Sta.Ana Total (14)	44.34	4407	25361	5250	32540	5947	33664	759	2.52	0.85	5.75	6.20	5.66
Urban Sub-Total (2)	3.54	708	3825	710	4336	627	3602	1018	1.26	-4.53	5.40	6.11	5.74
PAMPANGA TOTAL (175)	637.96	65221	440184	105144	576910	106557	542252	850	2.74	-1.54	6.75	5.49	5.09
Pampanga Urban Total (57)	140.20	48249	294872	72710	380635	71016	342717	2445	2.59	-2.59	6.11	5.23	4.83
Bamban Total (15)	143.14	3972	26072	6209	35639	3715	18008	126	3.18	-15.69	6.56	5.74	4.85
Urban Sub-Total (6)	3.13	2631	17838	4028	23240	1952	9428	3012	2.68	-20.19	6.78	5.77	4.83
Capas Total (8)	61.00	3053	18883	4539	25795	4036	19987	328	3.17	-6.18	6.19	5.68	4.95
Urban Sub-Total (5)	12.70	2028	12758	3031	17402	2426	12129	955	3.15	-8.63	6.29	5.74	5.00
Concepcion Total (43)	193.35	12296	76446	16162	97776	18900	100545	520	2.49	0.70	6.22	6.05	5.32
Urban Sub-Total (2)	1.66	1727	10333	1967	11482	1786	9045	5449	1.06	-5.79	5.98	5.84	5.06
TARLAC TOTAL (66)	397.49	19321	121401	26910	159210	26651	138540	349	2.75	-3.42	6.28	5.92	5.20
Tarlac Urban Total (13)	17.49	6386	40929	9026	52124	6164	30602	1750	2.45	-12.47	6.41	5.77	4.96
URBAN GRAND TOTAL (70)	157.69	54635	335801	81736	432759	77180	373319	2367	2.57	-3.63	6.15	5.29	4.84
GRAND TOTAL (241)	1035.45	84542	561585	132054	736120	133208	680792	657	2.74	-1.93	6.64	5.57	5.11

Source : NSO Census of Population in 1980 and 1990 and JICA survey for 1994.

Note : Figures in parentheses show the number of barangays in the municipality.

Table A.1.3 National Accounts by Sector of Origin (Percentage Distribution of GNP and GDP)

(Unit : billion pesos)

Sector	Constant 1985 Prices						Current
	1987	1988	1989	1990	1991	1992	1992
Agriculture, Fishery & Forestry	150.4	155.3	160.0	160.7	160.5	159.9	290.3
	(24.7)	*(23.8)*	*(23.2)*	*(22.3)*	*(22.2)*	*(21.9)*	*(21.2)*
Industry	215.1	232.5	251.6	258.1	248.7	247.5	446.7
	(35.5)	*(35.7)*	*(36.5)*	*(35.8)*	*(34.4)*	*(33.9)*	*(32.6)*
Mining and Quarrying	11.2	11.7	11.4	11.1	10.8	11.3	16.2
Manufacturing	154.6	167.7	178.4	184.0	183.1	181.3	329.9
Construction	31.7	33.2	41.4	42.6	35.7	36.0	66.9
Electricity, Gas and Water	18.6	19.9	20.4	20.4	20.6	20.4	33.7
Services	253.1	270.6	286.8	298.5	303.1	305.3	606.0
	(41.6)	*(41.5)*	*(41.6)*	*(41.4)*	*(42.0)*	*(41.8)*	*(44.2)*
Transportation	35.1	37.9	40.2	41.2	41.4	42.1	77.9
Trade	90.0	94.6	99.3	101.4	102.9	104.5	185.4
Finance and Housing	56.2	60.5	66.3	70.1	69.4	69.8	139.9
Other services	71.8	77.6	81.0	85.8	86.6	86.1	202.8
Gross Domestic Product (GDP)	619.6	658.4	698.4	717.3	712.3	712.7	1,342.5
	(101.8)	*(101.0)*	*(101.3)*	*(99.5)*	*(98.6)*	*(97.7)*	*(98.0)*
Growth of GDP (% p.a.)	-	*(06.3)*	*(06.1)*	*(02.7)*	*-(00.7)*	*(00.1)*	
Net Factor Income from Abroad	-11.0	-6.2	-8.7	3.7	10.0	17.1	27.5
Gross National Product(GNP)	608.6	652.2	689.7	721.0	722.3	729.8	1,370.0
	(100.0)	*(100.0)*	*(100.0)*	*(100.0)*	*(100.0)*	*(100.0)*	*(100.0)*
Growth of GNP (% p.a.)	-	*(07.2)*	*(05.7)*	*(04.5)*	*(00.2)*	*(01.0)*	

Source : National Statistical Coordination Board
Interim Report I of Master Plan Study for West Central Luzon Development Program

Table A.1.4 Major Indices of Two Provinces Related to the Study

		Provinces			
		Pampanga	Tarlac	Region III	Philippines
1. Area	sq.km	2,181	3,053	18,230	300,000
2. Population (1990)	thousand	1,532.6	859.2	6,198.5	60,685.0
Density (1990)	/sq.km	703	281	340	202
Growth rate (1970-80)	% p.a.	2.54	2.09	2.88	
(1980-90)	% p.a.	2.63	2.24	2.57	2.32
Urban population (1990)	%	70.5	29.8	60.3	48.5
Employment in agriculture	%	22.9	54.9	35.4	44.5
3. Economic structure (1990)					
Agriculture	%	16.0	31.6	22.8	22.7
Industry	%	42.2	32.0	39.2	35.4
Services	%	41.2	36.5	38.0	41.9
4. Gross regional domestic products (1990)	mill.Peso	22,650	10,614	94,158	1,066,224
Per capita GRDP (1990)	P	14,779	12,353	15,190	17,570
5. Land classification - A & D land	ha (%)	164,912 (75.6)	184,975 (60.6)	1,051,908(57.7)	
Land use (1991) - Agriculture land	ha (%)	104,421 (47.9)	137,400 (45.0)	635,345 (34.9)	
Grass/shrub lands	ha (%)	(9.0)	(27.8)	(33.2)	
Wood lands	ha (%)	(7.3)	(17.8)	(19.8)	
Paddy harvested area	ha	42,800	97,990	499,870	
Paddy yield	t/ha	3.91	2.54	3.50	
Irrigation service area	%	70.7	55.2		
6. Physical infrastructure					
Road density (1990)	km/sq.km	1.07	0.80 (0.89)	0.72	0.54
Household electrification	%	82.9	68.1		
Access to improved water supply (1990)	%	80.4	61.8	63.0	
No. of telephones (1990)	/100 popul'n	0.63	0.34	0.49	
7. Social infrastructure					
Population per hospital bed		903	1,197	896	
Enrollment ratio - Primary	%	111	111	111	
Secondary	%	75	78	76	
8. Major towns		San Fernando (157)	Tarlac (79)		
(urban population in 1990)	thousand	Angeles (236)			
		Mabalacat (111)			
		Guagua (88)			
		Apalit (62)			
		Macabebe (55)			
		Bacolor (50)			

Source: Prepared based on "Inception Report of the Master Plan Study for West Central Luzon Development Program" JICA, Nov. 1993.

Table A.1.5 Production of Rice before and after Pinatubo Eruption

	1989	1990	1991	1992
Volume (in MT)				
Philippines	9,458,800	9,319,300	9,673,262	9,128,940
Region III	1,684,950	1,910,930	1,747,589	1,815,936
Bataan	59,605	63,070	53,420	64,724
Bulacan	342,483	325,935	311,183	384,063
Nueva Ecija	768,477	971,763	921,451	865,804
Pampanga	192,530	202,758	167,449	165,113
Tarlac	256,116	272,178	248,662	300,533
Zambales	65,739	75,226	45,424	35,699
Harvested Area (in ha)				
Philippines	3,497,300	3,318,700	4,040,850	2,582,180
Region III	517,390	529,370	499,870	471,590
Bataan	17,160	17,300	16,770	17,050
Bulacan	84,630	79,110	83,810	83,540
Nueva Ecija	234,270	248,210	241,740	224,900
Pampanga	53,860	51,590	42,800	38,730
Tarlac	99,720	105,100	97,990	92,720
Zambales	27,750	28,060	16,760	14,650
Productivity (in MT/ha)				
Philippines	2.70	2.81	2.39	3.54
Region III	3.26	3.61	3.50	3.85
Bataan	3.47	3.65	3.19	3.80
Bulacan	4.05	4.12	3.71	4.60
Nueva Ecija	3.28	3.92	3.81	3.85
Pampanga	3.57	3.93	3.91	4.26
Tarlac	2.57	2.59	2.54	3.24
Zambales	2.37	2.68	2.71	2.44
Share in the Country's Production				
Region III	17.8%	20.5%	18.1%	19.9%
Bataan	0.6%	0.7%	0.6%	0.7%
Bulacan	3.6%	3.5%	3.2%	4.2%
Nueva Ecija	8.1%	10.4%	9.5%	9.5%
Pampanga	2.0%	2.2%	1.7%	1.8%
Tarlac	2.7%	2.9%	2.6%	3.3%
Zambales	0.7%	0.8%	0.5%	0.4%
Share in Region III Production				
Bataan	3.5%	3.3%	3.1%	3.6%
Bulacan	20.3%	17.1%	17.8%	21.1%
Nueva Ecija	45.6%	50.9%	52.7%	47.7%
Pampanga	11.4%	10.6%	9.6%	9.1%
Tarlac	15.2%	14.2%	14.2%	16.5%
Zambales	3.9%	3.9%	2.6%	2.0%

Source : Bureau of Agricultural Statistics, Department of Agriculture
Interim Report I of Master Plan Study for West Central Luzon Development Program

Table A.1.6 Socio-economic Profile of City/Municipality in the Study Area

City/Municipality	Area (sq.km)	Population 1990	Pop.density (per sq.km)	IncreaseRate 80-90.%.p.a.	Urban % in Total Pop.	Farm land % in Land Use**
Angeles City	62	236685	3807	2.28%	96.76%	1.14%
		32.20%				
Arayat	119	73189	613	2.58%	20.04%	55.75%
		9.90%				
Mabalacat	190	121115	638	4.11%	81.12%	2.83%
		16.50%				
Magalang	105	43940	419	2.35%	36.83%	36.17%
		6.00%				
Mexico	99	69441	702	2.64%	26.17%	90.49%
		9.40%				
Santa Ana	72	32540	452	2.52%	13.33%	38.68%
		4.40%				
Bamban	389	35639	92	3.18%	65.21%	6.16%
		4.80%				
Capas	99	25795	261	3.17%	67.46%*	28.52%
		3.50%				
	(261.42)	(61,205)	(234)	(2.78%)		
Concepcion	161	97776	608	2.49%	11.74%*	99.36%
		13.30%				
	(169.45)	(103,146)	(609)	(2.49%)		
Study Area Total	1296	736121	568	2.74%	58.79%	-
		100%				
Cf.San Fernando	81	157851	1944	3.59%	99.40%	5.63%
Philippine	300000	60685000	202	2.32%	48.50%	-
Region 3	18231	6199000	340	2.57%	60.30%	28.94%

Source: 1980 and 1990 "Census of Population and Housing" NSO

Note: * shows % of urban population in the Study Area.

** shows % of the "key production areas" designated by BSWM-Region III Office toward total area of each municipality.

Figures in the parentheses for Capas and Concepcion shows those for the total municipality including barangays outside the Study Area.

Table A.1.7 Migration of Aetas After the Pinatubo Eruption

Name of Resettlement/Evacuation Centers	Location of Resettlement/Evacuation Center	Area of Resettlement/ Evacuation Center (ha)	No. of Aeta Family/Population	Origin Barangay
1. Ayala, Magalang Evacuation Center	Barangay Ayala, Municipality of Magalang, Pampanga		199 (830)	Marcos Village, Mabalacat Pasbul, Mabalacat Sapang Bato, Angeles City
2. Planas, Staging Center	Barangay Planas, Porac, Pampanga	50 hectares	401 (1469)	Diaz,Camias Porac Don Bosco, Porac Liplip, Camias, Porac Pasbul, Camias, Porac Patal-Bato, Camias, Porac San Marcelino, Zambales Tanag, Porac
3. Floridablanca National Agricultural School (FNAS) Evacuation Center	Barangay Nabuclod, Floridablanca,Pampanga	1 hectare	61 (557)	Nabuclod Pasbul Labuan
4. Dueg Resettlement	Barangay Maasin, San Clemente, Tarlac	1,100 hectares	683 (3002)	A (3 sitios) - Patal Bato, Bamba - Patal Pinto, Tarlac - Mag-ube, Bambar B (2 sitios) - Flora - Bilad C (5 sitios) - Doray, - Settler, Zambales - Maalyabon - Bulacan - Kawayan D-1 (6 sitios) - Burag - Mataba - Malasa - Malanay - San Martin
5. Kalangitan Resettlement	Barangay Cutcut,Capas, Tarlac	123 hectares	1741 (1612)	Binyayan, Capas Kalangitan, Capas Flora, Capas Gayaman, Bamban Kawayan, Capas Malasa, Bamban Maruglu, Capas San Martin, Bamban
Total			3085 (7770)	

Table A.1.8 Consumer Price Index and Wholesale Price Index in the Philippines

		1988	1989	1990	1991	1992	1993	1994
CPI in the Philippines(1988=100)	All Items	100	112.2	128	152	165.6	176.4	193.2
	Inflation Rate(%)		12.2	14.2	18.7	8.9	7.5*	9.5**
	Food,beverage,tobacco	100	114	127.6	147.2	157.3	163.8	
	Inflation Rate(%)		14	11.93	15.36	6.86	4.13	
Whole Sale Price Index (1978=100)	All Items	498.5	550.7	607.5	678.7	717.4	705.4	
for National Capital Region	Inflation Rate(%)		10.47	10.31	11.72	5.70	-1.67	
	Food	587.7	672.6	747	806	850.6	835.2	
	Inflation Rate(%)		14.45	11.06	7.90	5.53	-1.81	
	Machinery & Trans.Equip.	427.4	444.6	489.3	536.8	538.4	552.7	
	Inflation Rate(%)		4.02	10.05	9.71	0.30	2.66	

Source : "Statistical Yearbook 1993" National Statistics Office

Note : * : Based on Medium-term Philippine Development Plan

** : Based on the estimate of GOP reported on "Inquirers" of November 14,1994

C.f.	1989-93	1989-94	1990-94	1991-94
CPI (all items) (% p.a.)	12	11.5	10.8	6.2

Table A.2.1 Unit Values of Damageable Properties applied for Project Evaluation

Items	Unit Value
I. Direct Damage	
1. Buildings*	
1) Residential Buildings	51,000 Pesos/building
2) Non-Residential	265,000 Pesos/building
3) Household effects	14,000 Pesos/building
4) Inventory stock/equipment	143,000 Pesos/building
2. Agricultural Crops	
Irrigated Paddy	12,650 Pesos/ha
Rainfed Paddy	9,440 Pesos/ha
Sugar Cane	20,930 Pesos/ha
Corn	9,810 Pesos/ha
5) Livestock	(estimated by 7% of crop damage)
3. Infrastructure	
6) Road	
National Road	1,750 Pesos/m
Other Roads	1,400 Pesos/m
7) Bridge	
National Bridge	60,000 Pesos/m
Local Bridge	50,000 Pesos/m
8) Irrigation System	640 Pesos/m
II. Indirect Damage	
9) Additional Transportation Cost	
10) Disruption of Economic Activity	
11) Evacuation Cost	216 Pesos/family/week
12) Emergency Clean-up Cost	150 Pesos/day/building

Source :

- Table 2-3 of Interim Report (2)
- Table 6.7 of Interim Report (1) for unit values of agricultural crops

Note :

* Values assumed as those after depreciated by 50%.

Table A.2.2 Damage Estimate of Buildings

A) Urban area : T=a*H + b*E + c*P -d*L
T=Number of building identified on 1 : 10,000 map :
Pre-eruption conditions for the affected area and post-eruption conditions for the non-affected areas.
H=Number of household in 1994 surveyed by DPI
E=Number of establishment based on "Establishment Survey 1993"
P=Public building such as primary school, health post etc.
L=Number of buildings lost by lahar incidence
a,b,c,d=constant to be determined by linear regression

B) Rural area : Tr=0.85 (Hr + Er) +7.7-0.47 Lr

Note:
1) Datas of "T", "H" and "E" were sufficiently available only for rural areas. Datas of "P" and "L" were not available. Therefore, the equation for rural areas were established as shown above and was applied for urban and rural areas commomly.
2) Also due to the lack of data, the equation was established only for Sacobia/Bamban rivers and was applied to Abacan river as well.

Application for Damage Estimate :
The inundation of one building on the inundation map will be assumed as the partial inundation of, not only residential building but, each factor of the equation such as establishment and public building.

Table A.2.3 Estimated Average Annual Damage under without-Project Condition for Abacan River

(A) Return Period	(B) Average Annual Probability of Exceedance for Return Period	(C) Events within Intervals	(D) Flood Damage up to Indicated Return Period (Pesos 10^6)	(E) Average Flood Damage (Pesos 10^6)	(F) Flood Damage within Intervals (Pesos 10^6)	(G) Average Annual Flood Damage up to Indicated Return Period (Pesos 10^6)
2	0.5		157.68			0.00
		0.3		240.47	72.14	
5	0.2		323.26			72.14
		0.1		411.23	41.12	
10	0.1		499.20			113.26
		0.05		597.16	29.86	
20	0.05		695.12			143.12
		0.03		816.65	24.50	
50	0.02		938.18			167.62
		0.01		1064.38	10.64	
100	0.01		1190.58			178.26

Table A.2.4 Estimated Average Annual Damage under without-Project Condition for Sacobia / Bamban Rivers

(A) Return Period	(B) Average Annual Probability of Exceedance for Return Period	(C) Events within Intervals	(D) Flood Damage up to Indicated Return Period (Pesos 10^6)	(E) Average Flood Damage (Pesos 10^6)	(F) Flood Damage within Intervals (Pesos 10^6)	(G) Average Annual Flood Damage up to Indicated Return Period (Pesos 10^6)
2	0.5		90.31			0.00
		0.3		137.07	41.12	
5	0.2		183.83			41.12
		0.1		232.37	23.24	
10	0.1		280.90			64.36
		0.05		331.58	16.58	
20	0.05		382.25			80.94
		0.03		436.15	13.08	
50	0.02		490.04			94.02
		0.01		553.72	5.54	
100	0.01		617.41			99.56

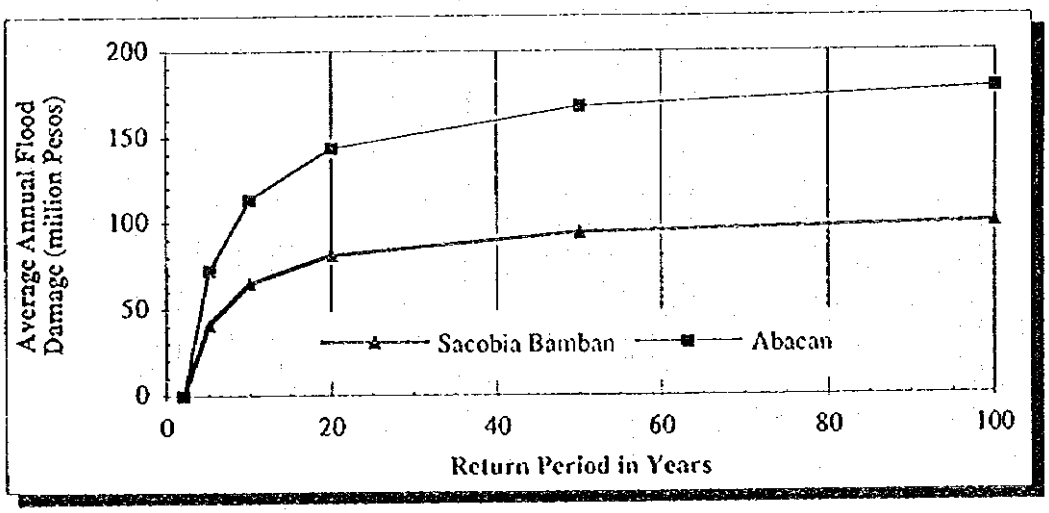


Table A.2.5 Traffic Surveys in the Study Area

	Road Section	Data Source	A Node	B Node	Car	Jeepney	Bus	Truck	Total	PCU	Others	
1)	CLOP Data											
	Mabalacat-Bamban(MNR)	LISR	3401	3535	6554	1874	1807	1629	11864	16237	0	1992
	San Fernando-Angeles(MNR)	NTCP87	3428	3429	6793	8577	3900	1973	21243	31405	0	1987
	Bamban-Capas	NTCP87	3532	3535	3855	1291	1755	1269	8170	11840	105	1987
	Angeles-San Fernando	ALT93	3437	3439	8197	0	2090	3094	13381	18565	0	1993
2)	LISR Data											
	SanFernando-Mabalacat(NLE)				11340	5873	2280	3096	22589			1992
	Mabalacat-Capas				5066	1467	1104	2010	9647			1992
3)	DPWH Data											
	Mabalacat-Bamban	DPWH Angeles			1231	728	117	922	2998		225	Nov.19,94
	Mabalacat-Concepcion	ditto			2401	4223	889	684	8197 *			Nov.7-13,94
									(10929)			Daily average
4)	Angeles-San Fernando(MNR)	Kampsax Int'l			12909	638	163	1379	15069		213	Nov.14,92
	ditto				13225	685	190	1562	15662		249	Nov.13,92
5)	San Francisco Bridge(#329)	JICA			3603	1805	1196	1080	7684 *			Aug.21-28,94
									(10245)			Daily average

Note :

*:	12 hrs survey data which was adjusted to 24 hrs data and is shown in the parentheses of the down column.
LISR:	Luzon Island Strategic Road Development Study, JICA, July 1993
NTCP:	National Traffic Count Program ,DPWH
ALT93:	Feasibility Study of the Proposed Alternate Arterial Roads in Central Luzon, 1994

Table A.2.6 DPWH Traffic Counting Survey in November 1994

Unit : Number of vehecles

	Mon. Nov.7	Tue. Nov.8	Wed. Nov. 9	Thu. Nov.10*	Fri. Nov. 11	Sat. Nov. 12	Sun. Nov. 13	Total	Daily Aver.
1) Car,Taxi,Van,Jeep	2623	2151	2292	2450	2373	2416	2504	16809	2401
	(34.8)	(27.5)	(27.6)	(28.3)	(27.7)	(28.5)	(31.3)	(29.3)	
2) Jeepney	3542	4248	4419	4487	4457	4436	3974	29563	4223
	(47.0)	(54.2)	(53.3)	(51.8)	(52.0)	(52.3)	(49.7)	(51.5)	
3) Small Bus	115	72	61	84	83	79	91	585	84
	(1.5)	(0.9)	(0.7)	(1.0)	(1.0)	(0.9)	(1.1)	(1.0)	
4) Big Bus	711	764	848	868	864	833	745	5633	805
	(9.4)	(9.8)	(10.2)	(10.0)	(10.1)	(9.8)	(9.3)	(9.8)	
5) Rigid Truck	442	536	607	692	708	635	598	4218	603
	(5.9)	(6.8)	(7.3)	(8.0)	(8.3)	(7.5)	(7.5)	(7.4)	
6) Articulated Truck	107	63	69	74	87	77	92	569	81
	(1.4)	(0.8)	(0.8)	(0.9)	(1.0)	(0.9)	(1.1)	(1.0)	
7) Total	7540	7834	8296	8655	8572	8476	8004	57377	8197
	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)

Source : DPWH-PDESO Angeles.
Notes : 1) Time of survey: 7:00 a.m. -19:00 p.m. from November 7 to November 13, 1994.
2) Site of survey : Station No. 021 in Mabalacat Municipality in Pampanga.
3) * : Original data covering 24 hrs. was adjusted to 12hrs. survey in this table.

Table A.2.7 Data for Additional Transportation Cost

(1) Computation Formula : $SCF = CFw/o - CFw/$

$CF = TDC * DF$

$TDC = (\sum_{i=1}^{4} VOCi * ADTi) * DL$

where , SCF = Cost saving by reduction of risk for road unserviceability caused by flood(P)
CF = Cost by flood(P)
TDC = Total traffic diversion cost(P)
DF =Duration of unserviceability(days)
VOCi = Vehicle operation cost of vehicle type i(P / vehicle-km)
ADTI = Average daily traffic volume of vehicle type I (vehicle / day)
DL = Detouring length (km)

(2) Vehicle Operating Cost(VOC)

	Car/van	Jeepney	Bus	Truck	
Vehicle Mix	0.469	0.235	0.156	0.141	
Running Cost(P/km)	2.29	1.61	3.65	4.93	
Fixed Cost(P/min.)	0.123	0.593	0.835	0.937	
ditto (P/km)	0.185	0.89	1.253	1.406	
Total Cost for Modal Mix(P/k	1.161	0.587	0.765	0.893	3.406

(3) Averag(Average speed assumed : 40km / hr

(4) Assumed Detour Routes, Distance and Duration of Unserviceability

Season/ Duration	Route Code	Distance (km) Detour	Normal	Bridge / Highway	No. of Vehicle	Route Alternatives
Normal Condition	N.1 :	-	86.5	B	1000	MNL-S/F-AGL-B-TLC
(through the year)	N.2 :	-	57.5	B	5000	S/F-B-TLC
	N.3:	-	27.9	B	5000	AGL-B-TLC
	N.4:	-	44.3	B	500	S/F-B-BB
	N.5 :	-	39.7	B	500	AGL-B-BB
	N.6:	-	10.1	B	500	S/F-S-CC
	N.7:	-	26.5	B	500	AGL-S-CC
For Dry Season	D.1 :	111.6	86.5	F	1000	MNL-MLS-F.Hwy-TLC
(6 months)	D.2 :	62.3	57.5	S	5000	S/F-S-CPS-TLC
	D.3:	44.5	27.9	S	5000	AGL-S-CPS-TLC
	D.4:	44.3	44.3	(B)	500	S/F-(B)-BB
	D.5 :	27.9	39.7	(B)	500	AGL-(B)-BB
	D.6 :	26.5	10.1	S	500	S/F-S-CC
	D.7:	10.1	26.5	S	500	AGL-S-CC
For Rainy Season	R.1.1:	111.6	86.5	F	1000	MNL-MLS-F.Hwy-TLC
(5 months)	R.1.2 :	62.3	57.5	S	5000	S/F-S-CPS-TLC
	R.1.3:	44.5	27.9	S	5000	AGL-S-CPS-TLC
	R.1.4:	50.5	44.3	S	500	S/F-S-BB
	R.1.5:	44.3	39.7	S	500	AGL-S-BB
	R.1.6 :	26.5	10.1	S	500	S/F-S-CC
	R.1.7:	32.7	26.5	S	500	AGL-S-CC
30 days in Rainy Season	R.2.1 :	111.6	86.5	F	1000	MNL-MLS-F.Hwy-TLC
(1 month)	R.2.2 :	154.4	57.5	F	5000	S/F-SRT-F.Hwy-TLC
	R.2.3:	166.8	27.9	F	5000	AGL-SRT-F.Hwy-TLC
	R.2.4:	151.3	44.3	F	500	S/F-SRT-F.Hwy-BB
	R.2.5 :	149	39.7	F	500	AGL-SRT-F.Hwy-BB
	R.2.6 :	166.8	10.1	F	500	S/F-SRT-F.Hwy-CC
	R.2.7:	151.3	26.5	F	500	AGL-SRT-F.Hwy-CC

Note : 1) "Vehicle Mix" was derived from the Traffic Survey conducted by JICA Study Team in August 1994.
2) Abbreviations : AGL:Angeles BB: Bamban CC: Concepcion MNL: Manila
S/F: San Fernando SRT: Santa Rita TLC: Tarlac
MLS: Malolos CPS: Capas F.Hwy: Friendship Highway
B : Bamban Bridge S : San Francisco Bridge F : Friendship Highway
(B) : Crossing the river bed at Bamban river

Table A.2.8 Detour Cost Computation

Unit : Peso thousand

Normal Route					Dry Season : 6 months						Rainy Season : 5 months						Rainy Season : 1 month					
Route		Vehicle	Bridge	(km)		Route	Vehicle	Bridge	(km)	Detour Cost		Route	Vehicle	Bridge	(km)	Detour Cost		Route	Vehicle	Bridge	(km)	Detour Cost
N.1	MNL-B-TLC	1000	B	86.5	D.1	MNL-F-TLC	1000	F	111.6	15388	R.1.1	MNL-F-TLC	1000	F	111.6	12824	R.2.1	MNL-F-TLC	1000	F	111.6	2565
N.2	S/F-B-TLC	5000	B	57.5	D.2	S/F-S-TLC	5000	S	62.3	14714	R.1.2	S/F-S-TLC	5000	S	62.3	12262	R.2.2	S/F-F-TLC	5000	F	136.6	40412
N.3	AGL-B-TLC	5000	B	39.7	D.3	AGL-S-TLC	5000	S	44.5	14714	R.1.3	AGL-S-TLC	5000	S	44.5	12262	R.2.3	AGL-F-TLC	5000	F	154.4	58601
																				F		
																				F		
N.4	S/F-B-BB	500	B	27.9	D.4	S/F-(B)-BB	500	(B)	27.9	0	R.1.4	S/F-S-BB	500	S	50.5	5773	R.2.4	S/F-F-BB	500	F	133.5	5395
N.5	AGL-B-BB	500	B	10.1	D.5	AGL-(B)-BE	500	(B)	10.1	0	R.1.5	AGL-S-BB	500	S	32.7	5773	R.2.5	AGL-F-BB	500	F	151.3	7214
																				F		
N.6	S/F-S-CC	500	S	44.3	D.6	S/F-S-CC	500	S	44.3	0	R.1.6	S/F-S-CC	500	S	44.3	0	R.2.6	S/F-F-CC	500	F	149	5349
N.7	AGL-S-CC	500	S	26.5	D.7	AGL-S-CC	500	S	26.5	0	R.1.7	AGL-S-CC	500	S	26.5	0	R.2.7	AGL-F-CC	500	F	166.8	7168
Total=										44816						48893						126704
	Bamban Bridge=			207897						44816						48893						114187
	San Francisco Bridge=			12517						0						0						12517
Grand Total=				220414																		

Abbreviations:

B : Bamban Bridge
S : San Francisco Bridge
F.Hwy : Friendship Highway
MNL : Manila
TLC : Tarlac
AGL : Angeles
BB : Bamban
S/F : San Fernand
CC : Concepcion
F : Friendship Highway

Note :

1) It was assumed in the dry season that some vehicles bound to Bamban cross the river bed of the Bamban river.
2) It was also assumed that some vehicles bound to Tarlac from Manila make a detour and take the Friendship Highway to avoid the congestion near the San Francisco Bridge.
3) In the Typhoon season, it was assumed that the access road to the San Francisco Bridge is inundated and not passable for 30 days in total. In this period, the vehicles bound to Tarlac from San Fernando and Angeles were assumed to make a detour via Santa Rita in stead of taking a route of Mexico-Arayat to avoid the flood prone area in Mexico.

Table A.2.9 Estimated Loss of Production by Interruption of Economic Activities caused by Flood

(1) GRDP of Region 3 in 1990 and Projection in 2010 (by CLDP Study)

(Peso 10^6, at 1990 price)

	1990	2010	Growth(%p.a.)
Agriculture	21,468	51,700	4.49
Industry	36,910	214,300	9.19
Services	35,780	192,100	8.77
Total	94,158	458,100	8.23

(2) Per Capita GRDP of Region 3 (Peso)

	1990	2010	Growth(%p.a.)	1994(estimated)
Population Region 3	6,199,016	10,501,000	2.67	6,888,061
Per capita GRDP(1990 price)	15,189	43,624	5.42	18,760
Per capita GRDP(1994 price)				26,710

(3) Per Capita GRDP of non-agricultural sector in Region 3 (Peso)

(Peso 10^6, at 1990 price)

		1990	2010	Growth(%p.a.)	1996
GRDP:	Industry	36,910	214,300	9.19	
	Services	35,780	192,100	8.77	
	Total	72,690	406,400	8.99	
	Urban Population in Region 3	3733797	8034000	3.91	
	Per capita GRDP of nas(Peso1990 pric	19468	50585	4.89	
	Ditto (Peso 1994 price)	27719	72023	4.89	36913

(4) Rural Population Growth rate (% p.a.)

	(Pampanga + Tarlac)	1055923	1096000	0.19

(5) Loss of GRDP caused by the Interruption of Economic Activities

= Number of affected Population * Per Capita GRDP of Non-agricultural Sector

Abacan : =28,910 presons * 60% (Urbanization Ratio) * P 36,910 (Per capita GRDP of non-agricultural sector in 1995) * 10 / 365 = P 17.54 million

Sacobia/ Bamban : 24,581 * 60% * P 36,910 * 10 /365 = P 14.91 million

Assumed Growth Rate : 4.89% p.a. = Growth Rate of GRDP of NAS for 1990-2010 (CLDP)

(6) GDP Deflator(IFS data)

	1989	1990	1991	1992	1993	1994(est.)
GDP	925.4	1073.1	1244.4	1351.6	1466.3	
GDP 1990price	1045.3	1073.1	1067.7	1074.4	1095.6	
GDP Deflator	88.53	100.00	116.55	125.80	133.84	142.38

Table A.2.10 Average Annual Cost for Evacuation and Building Clean-up In Abacan River

(A) Return Period	(B) Average Annual Probability of Exceedance for Return Period	(C) Events within Intervals	(D) Evacu. & Building Clean-up Costs up to Indicated Return Period (Evacu. Cost) (Pesos 10^6)	(Clean-up) (Pesos 10^6)	(E) Average Cost (Pesos 10^6)	(F) Average Cost within Intervals (Pesos 10^6)	(G) Average Annual Cost up to Indicated Return Period (Pesos 10^6)
2	0.5		5.02	2.09			0.00
		0.3			10.86	3.26	
5	0.2		10.31	4.30			3.26
		0.1			18.55	1.86	
10	0.1		15.88	6.62			5.11
		0.05			26.86	1.34	
20	0.05		22.04	9.18			6.46
		0.03			36.65	1.10	
50	0.02		29.70	12.37			7.56
		0.01			47.72	0.48	
100	0.01		37.67	15.69			8.03

Table A.2.11 Average Annual Cost for Evacuation and Building Clean-up In Sacobia/Bamban Rivers

(A) Return Period	(B) Average Annual Probability of Exceedance for Return Period	(C) Events within Intervals	(D) Evacu. & Building Clean-up Costs up to Indicated Return Period (Evacu. Cost) (Pesos 10^6)	(Clean-up) (Pesos 10^6)	(E) Average Cost (Pesos 10^6)	(F) Average Cost within Intervals (Pesos 10^6)	(G) Average Annual Cost up to Indicated Return Period (Pesos 10^6)
2	0.5		2.01	0.84			0.00
		0.3			4.33	1.30	
5	0.2		4.11	1.71			1.30
		0.1			7.41	0.74	
10	0.1		6.36	2.65			2.04
		0.05			10.68	0.53	
20	0.05		8.72	3.63			2.57
		0.03			14.05	0.42	
50	0.02		11.12	4.63			3.00
		0.01			17.74	0.18	
100	0.01		13.93	5.80			3.17

Table A.2.12 Project Cost of Flood / Mudflow Control Works for Sacobia/Bamban Rivers

(1) Alternative 1 — Unit : Pesos million

Work Items	Financial Cost			Economic Cost		
	F.C. Portion	L.C. Portion	Total	F.C. Portion	L.C. Portion	Total
1) Main Construction Cost	600.64	401.30	1001.94	600.64	276.09	876.74
2) Compensation Cost	0.00	9.00	9.00	0.00	3.69	3.69
3) Physical Contingency and Other Costs	150.16	100.32	250.49	150.16	69.02	219.18
4) Total	750.81	510.62	1261.43	750.81	348.80	1099.61

(2) Alternative 2 — Unit : Pesos million

Work Items	Financial Cost			Economic Cost		
	F.C. Portion	L.C. Portion	Total	F.C. Portion	L.C. Portion	Total
1) Main Construction Cost	1090.00	668.94	1758.94	1090.00	460.23	1550.23
2) Compensation Cost	0.00	9.00	9.00	0.00	3.69	3.69
3) Physical Contingency and Other Costs	272.50	167.23	439.73	272.50	115.06	387.56
4) Total	1362.50	845.17	2207.67	1362.50	578.98	1941.48

(3) Alternative 3 — Unit : Pesos million

Work Items	Financial Cost			Economic Cost		
	F.C. Portion	L.C. Portion	Total	F.C. Portion	L.C. Portion	Total
1) Main Construction Cost	2064.51	1320.53	3385.04	2064.51	908.53	2973.03
2) Compensation Cost	0.00	9.00	9.00	0.00	3.69	3.69
3) Physical Contingency and Other Costs	516.13	330.13	846.26	516.13	227.13	743.26
4) Total	2580.63	1659.67	4240.30	2580.63	1139.35	3719.98

(4) Alternative 4 — Unit : Pesos million

Work Items	Financial Cost			Economic Cost		
	F.C. Portion	L.C. Portion	Total	F.C. Portion	L.C. Portion	Total
1) Main Construction Cost	1161.77	716.79	1878.56	1161.77	493.15	1654.92
2) Compensation Cost	0.00	9.00	9.00	0.00	3.69	3.69
3) Physical Contingency and Other Costs	290.44	179.20	469.64	290.44	123.29	413.73
4) Total	1452.22	904.99	2357.20	1452.22	620.13	2072.35

Table A.2.13 Project Cost of Flood / Mudflow Control Works for Abacan River

Unit : Pesos million

Work Items	Financial Cost			Economic Cost		
	F.C. Portion	L.C. Portion	Total	F.C. Portion	L.C. Portion	Total
1) Main Construction Cost	379.19	251.65	630.84	379.19	173.14	552.33
3) Physical Contengency and Other Costs	94.80	62.91	157.71	94.80	54.10	148.90
3) Total	473.99	314.56	788.55	473.99	227.24	701.23

Note for Financial Cost :
1) At 1994 end price level.
2) Physical contingency and other costs = (1)* 25% which covers the physical contingency, administration and engineering services costs.

Note for Economic Cost :
1) Share of unskilled labour was assumed at 50% of Main Construction Cost.
2) Shadow Wage Rate of 60% was assumed.
3) Standard Coversion Factor of 0.86 was assumed.
4) Land acquisition cost was shadow-priced based on production foregone value.

Table A.2.14 Compensation Cost

1. Compensation Cost

1) Land Compensation Cost

-20 ha, within the total area of 35 ha land, of irrigated paddy was assumed.
The remaining land was assumed to be not utilized for production.

-From Interim Report(1) :

# Yield (ton/ha)	: 4.3
# Economic Price (P/ton)	: 5,300
# Production Cost (P/ha)	: 10,140
# Net Income (P/ha)	: 12,650

-Total Net Income : 35 ha * 12,650 (P/ha) =442,750 Peso / Year

-Capitalization : 442,750 / 0.12 = P3,689,600 (Discount Rate of 12 % was assumed)

2) Relocation Cost

-20 Houses * @50,000 (P/house) = P1,000,000

Table A.2.15 Cost-Benefit Analysis of Sacobia/Bamban Alternative-1

Unit : Peso million

No	Year	Economic Cost		Cost	Benefit			Benefit	B - C
		Capital	O & M	Total	Flood Cntrl	Transport	Others	Total	
1	1995	274.90	84.96	359.86					-359.86
2	1997	274.90	84.96	359.86					-359.86
3	1998	274.90	84.96	359.86					-359.86
4	1999	274.90	84.96	359.86					-359.86
5	2000		84.96	84.96	130.09	12.42	17.49	160.00	75.04
6	2001		84.96	84.96	140.80	12.65	18.22	171.68	86.72
7	2002		84.96	84.96	152.39	12.89	18.99	184.27	99.31
8	2003		84.96	84.96	164.93	13.14	19.80	197.87	112.91
9	2004		84.96	84.96	178.50	13.39	20.65	212.54	127.58
10	2005		4.38	4.38	193.19	13.64	21.53	228.37	223.99
11	2006		4.38	4.38	209.09	13.90	22.47	245.46	241.08
12	2007		4.38	4.38	226.30	14.17	23.44	263.91	259.52
13	2008		4.38	4.38	244.92	14.44	24.46	283.82	279.44
14	2009		4.38	4.38	265.08	14.71	25.54	305.33	300.94
15	2010		4.38	4.38	286.90	14.99	26.66	328.55	324.17
16	2011		4.38	4.38	310.51	0.00	27.84	338.35	333.97
17	2012		4.38	4.38	336.06	0.00	29.08	365.14	360.76
18	2013		4.38	4.38	363.72	0.00	30.38	394.10	389.72
19	2014		4.38	4.38	393.66	0.00	31.74	425.40	421.01
20	2015		4.38	4.38	426.05	0.00	33.17	459.22	454.84
21	2016		4.38	4.38	461.12	0.00	34.66	495.78	491.40
22	2017		4.38	4.38	499.07	0.00	36.24	535.30	530.92
23	2018		4.38	4.38	540.14	0.00	37.88	578.02	573.64
24	2019		4.38	4.38	584.59	0.00	39.61	624.20	619.82
25	2020		4.38	4.38	632.71	0.00	41.42	674.13	669.74
26	2021		4.38	4.38	684.78	0.00	43.32	728.10	723.71
27	2022		4.38	4.38	741.14	0.00	45.31	786.45	782.06
28	2023		4.38	4.38	802.13	0.00	47.40	849.53	845.15
29	2024		4.38	4.38	868.15	0.00	49.59	917.74	913.35
30	2025		4.38	4.38	939.59	0.00	51.89	991.48	987.10
								EIRR=	13.14%
								NPV(12%)=	166

Note :

-O & M Cost was computed at 0.5 % of the Main Construction Cost.

- Flood control benefit was assumed to grow at the same rate as that of GRDP (8.23% p.a.) of the Region.

-Transportation benefit was assumed to increase at the same growth as that of North Luzon Express Way(1.9% p.a.).

-Other benefit includes evacuation costs and building clean-up costs, and loss of production caused by the interruption of economic activities .

Table A.2.16 Cost-Benefit Analysis of Sacobia/Bamban Alternative-2

Unit : Peso million

No	Year	Economic Cost		Cost	Benefit			Benefit	B - C
		Capital	O & M	Total	Flood Cntrl	Transport	Others	Total	
1	1996	485.37	84.96	570.33	0.00	0.00	0.00	0.00	-570.33
2	1997	485.37	84.96	570.33	0.00	0.00	0.00	0.00	-570.33
3	1998	485.37	84.96	570.33	0.00	0.00	0.00	0.00	-570.33
4	1999	485.37	84.96	570.33	0.00	0.00	0.00	0.00	-570.33
5	2000		84.96	84.96	130.09	244.31	17.49	391.89	306.93
6	2001		84.96	84.96	140.80	248.95	18.22	407.97	323.01
7	2002		84.96	84.96	152.39	253.68	18.99	425.06	340.10
8	2003		84.96	84.96	164.93	258.50	19.80	443.23	358.27
9	2004		84.96	84.96	178.50	263.41	20.65	462.56	377.60
10	2005		7.75	7.75	193.19	268.41	21.53	483.14	475.39
11	2006		7.75	7.75	209.09	273.51	22.47	505.07	497.32
12	2007		7.75	7.75	226.30	278.71	23.44	528.45	520.70
13	2008		7.75	7.75	244.92	284.01	24.46	553.39	545.64
14	2009		7.75	7.75	265.08	289.40	25.54	580.02	572.27
15	2010		7.75	7.75	286.90	294.90	26.66	608.46	600.71
16	2011		7.75	7.75	310.51	0.00	27.84	338.35	330.60
17	2012		7.75	7.75	336.06	0.00	29.08	365.14	357.39
18	2013		7.75	7.75	363.72	0.00	30.38	394.10	386.35
19	2014		7.75	7.75	393.66	0.00	31.74	425.40	417.64
20	2015		7.75	7.75	426.05	0.00	33.17	459.22	451.47
21	2016		7.75	7.75	461.12	0.00	34.66	495.78	488.03
22	2017		7.75	7.75	499.07	0.00	36.24	535.30	527.55
23	2018		7.75	7.75	540.14	0.00	37.88	578.02	570.27
24	2019		7.75	7.75	584.59	0.00	39.61	624.20	616.45
25	2020		7.75	7.75	632.71	0.00	41.42	674.13	666.38
26	2021		7.75	7.75	684.78	0.00	43.32	728.10	720.35
27	2022		7.75	7.75	741.14	0.00	45.31	786.45	778.70
28	2023		7.75	7.75	802.13	0.00	47.40	849.53	841.78
29	2024		7.75	7.75	868.15	0.00	49.59	917.74	909.99
30	2025		7.75	7.75	939.59	0.00	51.89	991.48	983.73
	NPV=	1474	474	1948	1293	994	122	2408	460
					54%	41%	5%	(100)	
								EIRR=	14.55%
								NPV(12%)=	460

Note :

-O & M Cost was computed at 0.5 % of the Main Construction Cost.

- Flood control benefit was assumed to grow at the same rate as that of GRDP (8.23% p.a.) of the Region.

-Transportation benefit was assumed to increase at the same growth as that of North Luzon Express Way(1.9% p.a.).

-Other benefit includes evacuation costs and building clean-up costs, and loss of production caused by the interruption of economic activities .

Table A.2.17 Cost-Benefit Analysis of Sacobia/Bamban Alternative-3

Unit : Peso million

No	Year	Economic Cost		Cost	Benefit			Benefit	B - C
		Capital	O & M	Total	Flood Cntrl	Transport	Others	Total	
1	1996	930.00	84.96	1014.96					-1014.96
2	1997	930.00	84.96	1014.96					-1014.96
3	1998	930.00	84.96	1014.96					-1014.96
4	1999	930.00	84.96	1014.96					-1014.96
5	2000		84.96	84.96	130.09	244.31	17.49	391.89	306.93
6	2001		84.96	84.96	140.80	248.95	18.22	407.97	323.01
7	2002		84.96	84.96	152.39	253.68	18.99	425.06	340.10
8	2003		84.96	84.96	164.93	258.50	19.80	443.23	358.27
9	2004		84.96	84.96	178.50	263.41	20.65	462.56	377.60
10	2005		14.87	14.87	193.19	268.41	21.53	483.14	468.28
11	2006		14.87	14.87	209.09	273.51	22.47	505.07	490.21
12	2007		14.87	14.87	226.30	278.71	23.44	528.45	513.59
13	2008		14.87	14.87	244.92	284.01	24.46	553.39	538.53
14	2009		14.87	14.87	265.08	289.40	25.54	580.02	565.16
15	2010		14.87	14.87	286.90	294.90	26.66	608.46	593.60
16	2011		14.87	14.87	310.51	0.00	27.84	338.35	323.49
17	2012		14.87	14.87	336.06	0.00	29.08	365.14	350.28
18	2013		14.87	14.87	363.72	0.00	30.38	394.10	379.24
19	2014		14.87	14.87	393.66	0.00	31.74	425.40	410.53
20	2015		14.87	14.87	426.05	0.00	33.17	459.22	444.36
21	2016		14.87	14.87	461.12	0.00	34.66	495.78	480.92
22	2017		14.87	14.87	499.07	0.00	36.24	535.30	520.44
23	2018		14.87	14.87	540.14	0.00	37.88	578.02	563.16
24	2019		14.87	14.87	584.59	0.00	39.61	624.20	609.34
25	2020		14.87	14.87	632.71	0.00	41.42	674.13	659.26
26	2021		14.87	14.87	684.78	0.00	43.32	728.10	713.23
27	2022		14.87	14.87	741.14	0.00	45.31	786.45	771.58
28	2023		14.87	14.87	802.13	0.00	47.40	849.53	834.67
29	2024		14.87	14.87	868.15	0.00	49.59	917.74	902.87
30	2025		14.87	14.87	939.59	0.00	51.89	991.48	976.62
								EIRR=	8.69%
								NPV(12%)=	-909

Note :

-O & M Cost was computed at 0.5 % of the Main Construction Cost.

- Flood control benefit was assumed to grow at the same rate as that of GRDP (8.23% p.a.) of the Region.

-Transportation benefit was assumed to increase at the same growth as that of North Luzon Express Way(1.9% p.a.).

-Other benefit includes evacuation costs and building clean-up costs, and loss of production caused by the interruption of economic activities .

Table A 2.18 Cost-Benefit Analysis of Sacobia/Bamban Alternative-4

Unit : Peso million

No	Year	Economic Cost		Cost	Benefit			Benefit	B - C
		Capital	O & M	Total	Flood Cntrl	Transport	Others	Total	
1	1996	518.09	85.04	603.13					-603.13
2	1997	518.09	85.04	603.13					-603.13
3	1998	518.09	85.04	603.13					-603.13
4	1999	518.09	56.50	574.59					-574.59
5	2000		56.50	56.50	130.09	244.31	17.49	391.89	335.39
6	2001		56.50	56.50	140.80	248.95	18.22	407.97	351.47
7	2002		56.50	56.50	152.39	253.68	18.99	425.06	368.56
8	2003		56.50	56.50	164.93	258.50	19.80	443.23	386.73
9	2004		56.50	56.50	178.50	263.41	20.65	462.56	406.06
10	2005		8.27	8.27	193.19	268.41	21.53	483.14	474.87
11	2006		8.27	8.27	209.09	273.51	22.47	505.07	496.80
12	2007		8.27	8.27	226.30	278.71	23.44	528.45	520.18
13	2008		8.27	8.27	244.92	284.01	24.46	553.39	545.12
14	2009		8.27	8.27	265.08	289.40	25.54	580.02	571.75
15	2010		8.27	8.27	286.90	294.90	26.66	608.46	600.19
16	2011		8.27	8.27	310.51	0.00	27.84	338.35	330.08
17	2012		8.27	8.27	336.06	0.00	29.08	365.14	356.87
18	2013		8.27	8.27	363.72	0.00	30.38	394.10	385.83
19	2014		8.27	8.27	393.66	0.00	31.74	425.40	417.12
20	2015		8.27	8.27	426.05	0.00	33.17	459.22	450.95
21	2016		8.27	8.27	461.12	0.00	34.66	495.78	487.51
22	2017		8.27	8.27	499.07	0.00	36.24	535.30	527.03
23	2018		8.27	8.27	540.14	0.00	37.88	578.02	569.75
24	2019		8.27	8.27	584.59	0.00	39.61	624.20	615.93
25	2020		8.27	8.27	632.71	0.00	41.42	674.13	665.85
26	2021		8.27	8.27	684.78	0.00	43.32	728.10	719.82
27	2022		8.27	8.27	741.14	0.00	45.31	786.45	778.17
28	2023		8.27	8.27	802.13	0.00	47.40	849.53	841.26
29	2024		8.27	8.27	868.15	0.00	49.59	917.74	909.46
30	2025		8.27	8.27	939.59	0.00	51.89	991.48	983.21
								EIRR=	14.39%
								NPV(12%)=	443

Note :

-O & M Cost was computed at 0.5 % of the Main Construction Cost.

- Flood control benefit was assumed to grow at the same rate as that of GRDP (8.23% p.a.) of the Region.

-Transportation benefit was assumed to increase at the same growth as that of North Luzon Express Way(1.9% p.a.).

-Other benefit includes evacuation costs and building clean-up costs, and loss of production caused by the interruption of economic activities .

Table A.2.19 Cost-Benefit Analysis of Abacan Scheme

Unit : Peso million

No	Year	Economic Cost		Cost	Benefit			Benefit	B - C
		Capital	O & M	Total	Flood Cntrl	Transport	Others	Total	
1	1996	175.31	28.32	203.63					-203.63
2	1997	175.31	28.32	203.63					-203.63
3	1998	175.31	28.32	203.63					-203.63
4	1999	175.31	28.32	203.63					-203.63
5	2000		2.76	2.76	230.03	0.00	24.00	254.03	251.27
6	2001		2.76	2.76	248.96	0.00	24.87	273.83	271.07
7	2002		2.76	2.76	269.45	0.00	25.78	295.23	292.47
8	2003		2.76	2.76	291.63	0.00	26.74	318.37	315.60
9	2004		2.76	2.76	315.63	0.00	27.74	343.37	340.61
10	2005		2.76	2.76	341.61	0.00	28.79	370.40	367.63
11	2006		2.76	2.76	369.72	0.00	29.89	399.61	396.85
12	2007		2.76	2.76	400.15	0.00	31.05	431.19	428.43
13	2008		2.76	2.76	433.08	0.00	32.26	465.34	462.57
14	2009		2.76	2.76	468.72	0.00	33.53	502.25	499.49
15	2010		2.76	2.76	507.30	0.00	34.86	542.15	539.39
16	2011		2.76	2.76	549.05	0.00	36.25	585.30	582.54
17	2012		2.76	2.76	594.23	0.00	37.71	631.95	629.19
18	2013		2.76	2.76	643.14	0.00	39.25	682.39	679.63
19	2014		2.76	2.76	696.07	0.00	40.86	736.93	734.17
20	2015		2.76	2.76	753.36	0.00	42.54	795.90	793.14
21	2016		2.76	2.76	815.36	0.00	44.31	859.67	856.91
22	2017		2.76	2.76	882.46	0.00	46.16	928.63	925.87
23	2018		2.76	2.76	955.09	0.00	48.11	1003.20	1000.44
24	2019		2.76	2.76	1033.69	0.00	50.15	1083.84	1081.08
25	2020		2.76	2.76	1118.77	0.00	52.28	1171.05	1168.29
26	2021		2.76	2.76	1210.84	0.00	54.52	1265.37	1262.60
27	2022		2.76	2.76	1310.49	0.00	56.87	1367.37	1364.61
28	2023		2.76	2.76	1418.35	0.00	59.34	1477.69	1474.92
29	2024		2.76	2.76	1535.08	0.00	61.92	1597.00	1594.24
30	2025		2.76	2.76	1661.41	0.00	64.63	1726.05	1723.29
								EIRR=	28.17%
								NPV(12%)=	1814

Note :

-O & M Cost was computed at 0.5 % of the Main Construction Cost.

- Flood control benefit was assumed to grow at the same rate as that of GRDP (8.23% p.a.) of the Region.

-Transportation benefit was assumed to increase at the same growth as that of North Luzon Express Way(1.9% p.a.).

-Other benefit includes evacuation costs and building clean-up costs, and loss of production caused by the interruption of economic activities .

Table A.2.20 Affected Area for Flood of 20-year Return Period

		Affected Area (sq.m)	Affected Household 1994	Affected Cultivable Land (sq.m)
	Abacan River Basin			
12009	ANGELES CITY	1,850,000	1,021	0
12012	ARAYAT	50,000	3	34,278
12021	MEXICO	17,390,000	3,276	7,005,648
12022	SANTA ANA	9,920,000	1,018	8,358,761
	Sub Total	29,210,000	5,318	15,398,687
	Bamban River Basin			
22010	MABALACAT	2,010,000	31	33,348
22011	MAGALANG	4,610,000	69	3,886,651
22315	CAPAS	0	0	0
22316	CONCEPCION	48,280,000	3,874	24,005,071
22317	BAMBAN	3,260,000	580	146,536
	SubTotal	58,160,000	4,554	28,071,606
	Total	87,370,000	9,872	43,470,293

Table A.2.21 Abstract from Barangay Database of Probable Inundation Area in Sacobia-Bamban River

Sacobia River System						No.of Buildings		Land	Infrastructure			Total Value of Assets (X 1000 pesos)		
Province	Municipality	Barangay	Area in sq.km	Population 1994	House Holds 1994	Residential	Non-Res	Cultivable Area (ha)	Road Length (m)	No. of Bridges	Irrigation Scheme (m)	Buildings	Land	Infrastructure
PAMPANGA	MABALACAT	CACUTUD	1.99	840	200	8	5	0	171	0	7,101	521	0	258
		DOLORES	5.45	256	49	1,721	2	7	5,569	0	0	1,329	66	5,030
		MAMATITANG	2.01	1,291	233	261	1	0	0	0	518	7,558	0	243
		SAN JOAQUIN	6.63	4,402	902	1,225	2	72	6,155	0	0	35,724	565	9,729
		SAPANGBALEN	11.33	0	0	98	0	0	0	0	14,830	0	0	3,010
		STA. INES	2.77	3,580	780	28	14	1	0	0	6,233	36,159	11	3,902
		TABUN	5.61	0	0	571	0	3	2,576	1	0	0	31	801
	MABALACAT		35.79	10,369	2,164	3,912	24	83	14,471	1	28,682	81,291	673	22,972
	MAGALANG	NAVALING	4.26	985	163	187	0	374	0	0	47,681	6,211	2,879	26,823
		SAN AGUSTIN	31.29	1,500	240	0	3	6	0	0	10,302	11,080	49	6,593
		SAN ROQUE	6.82	1,879	321	0	0	682	0	0	76,398	13,915	5,252	48,894
		STO. ROSARIO	10.52	2,690	488	0	0	402	0	0	41,112	17,679	3,094	21,989
		TURU	25.46	896	140	106	0	2,306	0	0	107,211	6,068	17,759	68,607
	MAGALANG		78.35	7,950	1,352	293	3	3,770	0	0	282,703	54,954	29,033	172,906
TARLAC	BAMBAN	BANABA	0.44	820	220	755	0	27	5,311	0	0	7,338	295	5,721
		BANGCU	2.24	0	0	68	0	9	0	1	2,562	0	94	307
		LA PAZ	2.19	602	123	90	1	112	0	0	0	2,842	1,230	0
		LOURDES	1.43	765	163	1,660	22	7	15,165	0	0	11,974	80	21,148
		MALONZO	2.36	0	0	123	0	0	0	0	25,273	0	0	348
		PACALCAL	2.35	666	128	33	0	141	0	0	0	3,335	1,555	0
		SAN NICOLAS (POB.)	1.14	5,780	1,140	1,409	57	4	268	2	0	7,934	49	188
		SAN PEDRO	4.18	0	0	428	0	9	0	1	0	0	97	14
		SAN VICENTE	1.10	534	120	0	0	0	0	0	0	4,945	0	0
		STO. NINO	1.31	668	150	0	0	0	0	0	0	6,503	0	0
	BAMBAN		18.72	9,835	2,044	4,566	80	309	20,744	4	27,835	44,871	3,400	27,726
	CONCEPCION	BALUTU	2.07	4,380	700	163	0	28	0	0	8,377	4,152	214	734
		CAFE	8.04	1,983	365	61	0	203	0	0	4,047	4,001	2,236	655
		CALIUS GUECO	0.58	1,320	240	9	1	56	0	0	0	10,283	431	0
		CASTILLO	17.56	2,180	420	115	0	1,049	0	0	0	10,874	10,151	0
		CULATINGAN	6.22	2,229	399	4	0	309	0	0	5,976	8,595	3,402	1,901
		DUNGAN	7.65	673	130	470	0	554	3,835	1	14	4,731	6,090	4,976
		GREEN VILLAGE	0.90	1,395	277	647	0	6	1,603	0	76	12,008	64	2,293
		LILIBANGAN	4.00	700	140	353	0	35	0	0	0	864	269	0
		MAGAO	8.91	2,740	460	356	0	67	0	0	1,125	1,504	739	54
		MALUPA	2.14	1,460	280	231	0	72	0	0	0	4,092	795	0
		MINANE	2.82	4,420	720	1,481	6	45	15,527	3	3,687	17,138	496	13,551
		PANALICSICAN	9.57	1,240	240	705	0	937	0	0	39,280	10,190	7,593	24,623
		SAN ANTONIO	4.54	3,380	520	240	1	311	1,854	1	2,344	16,386	2,398	3,343
		SAN BARTOLOME	5.01	2,040	360	690	0	499	290	0	24,667	15,557	3,845	16,142
		SAN FRANCISCO	3.06	4,839	942	642	3	226	8,028	0	0	31,833	2,485	8,618
		SAN ISIDRO	7.79	2,560	480	850	0	776	0	0	47,151	20,740	5,977	30,079
		SAN JOSE (POB.)	0.67	6,248	1,195	418	60	38	1,079	0	0	65,318	419	1,510
		SAN MARTIN	3.65	1,000	240	178	0	1	68	0	0	36	14	0
		SAN NICOLAS (POB.)	0.99	2,797	591	611	473	9	4,208	0	6,254	132,163	94	9,894
		SAN NICOLAS BALAS	6.07	2,860	480	640	2	179	6,443	1	28,537	11,505	1,380	15,063
		SAN VICENTE	3.26	1,340	240	31	19	19	526	2	6,274	1,849	198	737
		STA. MONICA	7.13	3,980	747	0	3	692	0	0	0	33,058	7,617	0
		STA. RITA	3.08	4,080	960	884	4	8	2,841	2	15,082	2,361	90	818
		STO. CRISTO	0.54	1,000	240	141	1	53	2,245	0	0	10,426	581	3,082
		TALIM, MARIMLA	4.00	1,231	223	377	0	86	0	0	0	2,223	939	0
		TALIM, SAN MIGUEL	5.44	1,160	240	34	2	530	0	0	0	10,855	5,826	0
		TELABANCA	9.31	946	174	548	0	5	0	0	57,239	392	56	1,906
	CONCEPCION		135.06	64,181	12,003	10,879	575	6,794	48,546	10	250,129	443,136	64,398	139,979
			267.93	92,335	17,563	19,650	682	10,957	83,761	15	589,349	624,252	97,504	363,584

Table A.2.22 Abstract from Barangay Database of Probable Inundation Area in Abacan River

Abacan River System						No.of Buildings		Land	Infrastructure			Total Value of Assets (x 1000 pesos)		
Province	Municipality	Barangay	Area in sq.km	Population 1994	House Holds 1994	Residential	Non-Res	Cultivable Area (ha)	Road Length (m)	No. of Bridges	Irriga-tion Scheme (m)	Buildings	Land	Infra-structure
PAMPANGA	ANGELES CITY	CAPAYA	1.66	4,095	815	693	0	0	4,940	0.0	0	25,180	0	4,929
		PANDAN	0.97	7,992	1,590	1,352	14	0	3,076	1.0	0	36,502	0	2,550
		PULONG MARAGUL	1.52	8,120	1,660	1,411	0	0	24,293	0.0	0	59,469	0	28,107
		SALAPUNGAN	2.09	5,122	998	848	68	0	56,419	0.0	0	56,828	0	77,550
		SAPALIBUTAD	2.17	2,900	540	459	0	0	7,075	0.0	0	20,515	0	9,145
		TABUN	1.06	1,341	258	219	0	0	8,981	1.0	0	6,803	0	7,982
	ANGELES		9.47	29,570	5,861	4,982	82	0	104,784	2.0	0	205,296	0	130,263
	ARAYAT	ARENAS	3.88	2,520	400	340	0	271	3,490	0.0	0	17,340	2,088	4,886
		LACMIT	5.15	3,440	620	527	0	515	0	0.0	9,250	26,877	3,962	5,920
		SAN ANTONIO	5.23	1,900	340	289	0	358	6,532	0.0	0	14,739	2,760	9,223
	ARAYAT		14.25	7,860	1,360	1,156	0	1,144	10,023	0.0	9,250	58,956	8,810	20,029
	MEXICO	ANAO	1.08	1,972	355	302	0	0	1,843	0.0	1,440	15,389	0	3,502
		BALAS	2.05	1,420	320	272	4	11	5,807	1.0	0	812	87	477
		BUENAVISTA	3.95	911	137	116	1	103	0	0.0	1,065	6,121	791	677
		CAMUNING	1.84	1,374	220	187	0	0	1,879	0.0	7,474	9,537	0	7,414
		CAWAYAN	3.18	743	150	128	1	0	1,940	0.0	0	5,546	0	2,798
		CONCEPCION	0.67	1,400	260	221	1	37	0	0.0	0	6,320	285	0
		CULUBASA	1.57	1,693	290	238	4	0	130	0.0	0	2,867	0	40
		DIVISORIA	2.20	1,125	193	164	2	144	2,836	0.0	12,275	5,783	1,496	7,756
		DOLORES (PIRING)	2.67	1,222	194	165	1	131	3,415	1.0	0	4,218	1,006	2,604
		EDEN	2.23	540	90	77	0	0	2,691	0.0	0	3,474	0	3,355
		GANDUS	3.24	490	85	72	0	0	8,501	0.0	0	3,593	0	11,605
		LAGUNDI	2.65	2,340	480	408	14	192	1,920	0.0	0	23,962	2,057	2,687
		LAPUT	1.18	1,451	234	199	0	0	0	0.0	0	0	0	0
		LAUG	1.59	1,980	340	289	0	159	442	0.0	1,084	14,739	1,287	1,312
		MASAMAT	2.58	620	140	119	0	51	54	0.0	0	6,069	399	75
		MASANGSANG	2.76	1,797	338	287	16	161	11,989	1.0	367	18,256	1,674	17,570
		PANGATLAN	5.90	1,281	201	171	1	38	2,192	0.0	11,790	5,302	296	6,296
		PARIAN (POB.)	0.39	4,680	820	697	67	39	0	0.0	0	50,639	299	0
		SABANILLA	1.23	900	200	170	1	107	0	0.0	0	8,895	825	0
		SAN ANTONIO	0.28	4,160	740	629	13	22	0	0.0	0	27,611	170	0
		SAN CARLOS	0.84	1,974	400	340	8	84	0	0.0	0	19,142	643	0
		SAN JOSE MALINO	2.39	3,532	585	497	5	135	3,966	0.0	0	25,588	1,042	5,364
		SAN JOSE MATULID	2.22	2,380	360	306	0	143	5,238	3.0	1,215	12,287	1,441	7,685
		SAN JUAN	1.01	2,351	458	389	0	52	0	0.0	0	10,260	401	0
		SAN ROQUE	1.54	660	120	102	1	154	0	2.0	0	5,427	1,186	1,100
		SAN VICENTE	2.19	2,677	425	361	0	219	0	0.0	0	18,424	1,690	0
		STA. CRUZ	3.21	1,569	274	233	1	209	4,647	3.0	0	8,055	1,612	5,428
		STA. MARIA	1.73	1,778	355	302	3	173	439	0.0	0	16,065	1,335	614
		STO. DOMINGO	1.85	1,253	255	217	13	185	2,923	0.0	0	13,983	1,426	4,092
		STO. ROSARIO	3.28	2,020	400	340	5	13	546	1.0	0	746	102	53
		SUCLABAN	3.14	622	102	87	0	0	37	0.0	0	2,005	0	24
		TANGLAY (TANGLE)	2.25	779	140	119	0	0	0	0.0	0	4,591	0	0
	MEXICO		68.88	53,694	9,651	8,203	162	2,564	63,433	12.0	36,709	355,705	21,551	92,528
	SANTA ANA	SAN AGUSTIN	5.30	1,931	339	288	1	311	5,908	0.0	0	8,754	2,393	4,852
		SAN BARTOLOME	2.71	1,242	224	190	5	215	0	0.0	0	10,837	1,658	0
		SAN ISIDRO	3.00	4,780	800	680	3	300	0	0.0	260	35,356	2,503	166
		SAN JOAQUIN (POB.)	2.05	2,198	368	313	66	136	0	1.0	0	30,819	1,048	550
		SAN JUAN	1.49	1,404	259	220	3	149	245	0.0	0	11,903	1,148	343
		SAN PABLO	3.96	3,080	580	493	0	344	4,565	0.0	0	25,143	2,647	6,391
		SAN PEDRO	1.66	1,047	160	136	0	166	1,222	0.0	1,212	6,936	1,303	2,486
		SAN ROQUE	5.29	2,412	393	334	1	359	6,468	0.0	580	11,695	2,762	6,387
		SANTIAGO	3.11	2,647	471	400	0	311	0	0.0	0	20,418	2,398	0
		SANTO ROSARIO	4.04	663	113	96	417	404	0	0.0	5,325	98,828	3,111	3,408
	SANTA ANA		32.62	21,404	3,707	3,151	496	2,696	18,408	1.0	7,377	260,688	20,972	24,583
	Total		125.22	112,528	20,579	17,492	740	6,403	196,647	15.00	53,335	880,645	51,333	267,403

Table A.2.23 Probable Flood/Mudflow Damage by Return Period in Sacobia-Bamban River (1 of2)

Sacobia River System			Flood Damages by Return Period (x1000 pesos)			Flood Damages by Return Period (x1000 pesos)			Flood Damages by Return Period (x1000 pesos)			Flood Damages by Return Period (x1000 pesos)		
			2 years			5 years			10 years			20 years		
Province	Municipality	Barangay	Buildings	Land	Infra-structure	Buildings	Land	Infra-structure	Buildings	Land	Infra-structure	Buildings	Land	Infra-structure
PAMPANGA	MABALACAT	CACUTUD	135.45	0.00	41.22	140.66	0.00	41.22	161.50	0.00	48.94	161.50	0.00	48.94
		DOLORES	146.17	14.46	452.73	159.46	15.12	452.73	212.62	17.75	603.64	239.19	19.06	704.25
		MAMATITANG	1,360.39	0.00	24.28	1,360.39	0.00	24.28	1,662.70	0.00	31.56	1,738.28	0.00	31.56
		SAN JOAQUIN	2,500.71	56.45	486.45	2,857.96	62.10	583.74	3,572.45	73.39	681.03	3,572.45	73.39	778.32
		SAPANGBALEN	0.00	0.00	150.52	0.00	0.00	150.52	0.00	0.00	150.52	0.00	0.00	150.52
		STA. INES	723.18	0.34	39.02	1,084.77	0.69	78.04	1,446.36	0.80	78.04	1,446.36	0.80	78.04
		TABUN	0.00	9.89	96.07	0.00	9.89	104.08	0.00	10.82	120.09	0.00	11.44	136.10
	MABALACAT		4,865.91	81.15	1,290.27	5,603.24	87.79	1,434.59	7,055.62	102.75	1,713.81	7,157.77	104.68	1,927.72
	MAGALANG	NAVALING	558.98	892.46	2,414.04	558.98	921.25	2,414.04	621.09	950.04	2,414.04	621.09	978.83	2,414.04
		SAN AGUSTIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		SAN ROQUE	278.31	367.66	977.89	278.31	367.66	977.89	278.31	367.66	977.89	278.31	367.66	977.89
		STO. ROSARIO	707.18	309.36	659.67	707.18	309.36	659.67	707.18	340.29	659.67	707.18	340.29	659.67
		TURU	303.42	2,841.49	3,430.36	303.42	2,841.49	3,430.36	303.42	2,841.49	2,744.29	242.73	2,841.49	2,744.29
	MAGALANG		1,847.88	4,410.97	7,481.96	1,847.88	4,439.76	7,481.96	1,909.98	4,499.48	6,795.89	1,849.30	4,528.27	6,795.89
TARLAC	BAMBAN	BANABA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		BANGCU	0.00	39.29	36.86	0.00	42.10	36.86	0.00	44.91	39.94	0.00	50.52	55.30
		LA PAZ	85.27	86.07	0.00	85.27	86.07	0.00	85.27	86.07	0.00	142.12	110.66	0.00
		LOURDES	0.00	1.61	0.00	119.74	2.41	211.48	0.00	1.61	0.00	0.00	1.61	0.00
		MALONZO	0.00	0.00	20.89	0.00	0.00	20.89	0.00	0.00	20.89	0.00	0.00	20.89
		PACALCAL	66.70	93.31	0.00	66.70	93.31	0.00	66.70	93.31	0.00	66.70	93.31	0.00
		SAN NICOLAS (POB.)	2,538.76	24.87	45.11	2,538.76	24.38	43.23	3,332.12	29.26	60.15	2,776.76	29.26	45.11
		SAN PEDRO	0.00	38.84	2.65	0.00	39.81	2.79	0.00	43.70	3.21	0.00	46.61	3.07
		SAN VICENTE	1,335.23	0.00	0.00	1,236.33	0.00	0.00	1,384.68	0.00	0.00	1,503.04	0.00	0.00
		STO. NINO	1,040.40	0.00	0.00	1,105.43	0.00	0.00	1,105.43	0.00	0.00	1,105.43	0.00	0.00
	BAMBAN		5,066.36	284.00	105.52	5,152.22	288.09	315.26	5,974.20	298.86	124.19	5,624.05	331.97	124.37
	CONCEPCION	BALUTU	124.56	32.09	22.01	124.56	32.09	22.01	124.56	32.09	22.01	124.56	32.09	22.01
		CAFE	160.03	380.16	19.65	160.03	380.16	19.65	160.03	380.16	26.20	160.03	402.52	26.20
		CALIUS GUECO	822.66	111.99	0.00	822.66	111.99	0.00	822.66	120.60	0.00	925.49	133.52	0.00
		CASTILLO	543.68	3,045.32	0.00	543.68	3,045.32	0.00	543.68	3,045.32	0.00	434.94	3,045.32	0.00
		CULATINGAN	687.64	952.63	133.05	687.64	952.63	133.05	601.68	952.63	133.05	515.73	952.63	114.04
		DUNGAN	47.31	182.69	49.76	47.31	182.69	49.76	47.31	182.69	49.76	47.31	182.69	49.76
		GREEN VILLAGE	1,801.19	26.36	229.29	2,041.35	27.00	252.22	1,921.27	27.00	229.29	2,041.35	28.29	252.22
		LILIBANGAN	25.92	40.36	0.00	25.92	40.36	0.00	25.92	40.36	0.00	25.92	40.36	0.00
		MAGAO	75.22	162.61	2.72	75.22	162.61	2.72	75.22	162.61	2.72	75.22	162.61	2.17
		MALUPA	245.55	143.08	0.00	286.47	151.03	0.00	327.40	166.92	0.00	327.40	174.87	0.00
		MINANE	1,885.19	228.20	1,355.08	2,036.57	238.12	1,355.08	2,399.33	248.05	1,490.59	2,570.71	272.85	1,490.59
		PANALICSICAN	815.23	2,885.24	1,969.83	815.23	2,961.17	1,969.83	917.14	3,113.02	1,969.83	917.14	3,340.80	1,969.83
		SAN ANTONIO	1,147.01	695.29	200.59	1,147.01	695.29	234.02	1,310.87	743.24	234.02	1,474.73	815.17	234.02
		SAN BARTOLOME	1,089.01	999.73	1,129.94	1,244.59	1,038.18	1,129.94	1,244.59	1,076.63	1,129.94	1,400.16	1,115.08	1,291.36
		SAN FRANCISCO	3,819.91	844.86	861.85	4,138.23	869.71	861.85	4,456.56	919.41	861.85	4,456.56	993.95	948.03
		SAN ISIDRO	1,451.81	1,673.60	2,105.50	1,451.81	1,673.60	2,105.50	1,659.22	1,793.15	2,105.50	1,866.62	1,852.92	2,105.50
		SAN JOSE (POB.)	13,716.83	196.88	196.30	14,370.02	201.07	211.40	14,370.02	201.07	196.30	15,676.38	201.07	211.40
		SAN MARTIN	1.09	1.27	0.01	1.09	1.27	0.01	1.46	1.41	0.01	1.82	1.41	0.01
		SAN NICOLAS (POB.)	6,608.16	16.97	494.71	6,608.16	16.97	494.71	6,608.16	16.97	494.71	7,929.79	17.91	494.71
		SAN NICOLAS BALAS	1,150.49	441.60	1,355.71	1,150.49	441.60	1,355.71	1,265.54	455.40	1,355.71	1,265.54	496.80	1,506.34
		SAN VICENTE	129.44	29.63	36.84	129.44	29.63	36.84	129.44	29.63	36.84	129.44	29.63	36.84
		STA. MONICA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		STA. RITA	165.29	18.00	40.90	188.90	18.00	40.90	188.90	18.90	40.90	212.51	20.70	49.08
		STO. CRISTO	208.53	34.84	61.65	208.53	34.84	61.65	208.53	34.84	61.65	104.26	34.84	30.82
		TALIM. MARIMLA	177.82	309.75	0.00	177.82	328.52	0.00	177.82	356.68	0.00	177.82	375.45	0.00
		TALIM. SAN MIGUEL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		TELABANCA	47.09	20.10	190.60	51.02	20.66	190.60	58.87	21.78	209.66	62.79	23.45	209.66
	CONCEPCION		36,946.65	13,473.24	10,465.95	38,583.73	13,654.50	10,527.41	39,646.14	14,140.55	10,650.50	42,924.21	14,746.94	11,044.58
			48,726.79	18,249.35	19,333.70	51,157.06	18,470.14	19,759.21	54,585.94	19,041.64	19,284.38	57,555.34	19,711.87	19,892.55

Table A.2.23 Probable Flood/Mudflow Damage by Return Period in Sacobia-Bamban River (2 of2)

Sacobia River System			Flood Damages by Return Period (x1000 pesos)			Flood Damages by Return Period (x1000 pesos)			Affected Area (sq.km.)	
			50 years			100 years				
Province	Municipality	Barangay	Buildings	Land	Infra-structure	Buildings	Land	Infra-structure	20 years	100 years
PAMPANGA	MABALACAT	CACUTUD	171.92	0.00	54.10	182.34	0.00	54.10	0.00	1.62
		DOLORES	279.06	21.03	804.85	345.50	26.95	955.76	0.57	2.72
		MAMATITTANG	1,965.01	0.00	36.42	2,116.17	0.00	38.84	0.00	0.09
		SAN JOAQUIN	3,929.69	79.03	778.32	4,644.18	95.97	972.89	0.19	0.72
		SAPANGBALEN	0.00	0.00	180.62	0.00	0.00	180.62	0.14	4.53
		STA. INES	1,807.95	0.92	117.06	2,169.54	1.14	117.06	0.00	0.23
		TABUN	0.00	12.98	152.11	0.00	16.69	176.13	1.11	3.64
	MABALACAT		8,153.62	113.96	2,123.47	9,457.72	140.75	2,495.40	2.01	13.55
	MAGALANG	NAVALING	683.20	1,065.20	2,414.04	1,304.28	1,900.08	3,486.95	0.70	4.10
		SAN AGUSTIN	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.43
		SAN ROQUE	278.31	367.66	977.89	139.15	525.23	488.95	0.09	1.50
		STO. ROSARIO	883.97	371.23	659.67	883.97	525.90	659.67	0.41	2.87
		TURU	242.73	3,019.08	2,744.29	242.73	4,617.42	2,058.22	3.34	14.34
	MAGALANG		2,088.20	4,823.16	6,795.89	2,570.14	7,568.63	6,693.78	4.61	23.24
TARLAC	BAMBAN	BANABA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
		BANGCU	0.00	54.26	64.51	0.00	67.36	86.02	1.11	1.91
		LA PAZ	113.70	110.66	0.00	198.97	147.55	0.00	0.10	0.41
		LOURDES	119.74	2.41	211.48	0.00	2.41	0.00	0.00	0.13
		MALONZO	0.00	0.00	27.86	0.00	0.00	34.82	0.27	1.31
		PACALCAL	66.70	93.31	0.00	100.05	155.52	0.00	0.01	0.47
		SAN NICOLAS (POB.)	3,570.12	33.16	54.51	4,601.49	39.01	65.79	0.57	1.06
		SAN PEDRO	0.00	54.38	3.90	0.00	67.00	4.18	1.18	3.44
		SAN VICENTE	1,384.68	0.00	0.00	1,582.50	0.00	0.00	0.00	0.16
		STO. NINO	1,105.43	0.00	0.00	1,105.43	0.00	0.00	0.02	0.24
	BAMBAN		6,360.37	348.19	362.27	7,588.44	478.86	190.81	3.26	9.14
	CONCEPCION	BALUTU	166.08	36.37	22.01	207.60	47.07	29.34	0.30	0.82
		CAPE	160.03	424.89	26.20	120.02	491.97	19.65	1.68	3.24
		CALIUS GUECO	1,131.16	163.67	0.00	1,131.16	211.05	0.00	0.11	0.44
		CASTILLO	761.15	4,669.49	0.00	1,087.36	6,090.64	0.00	14.82	17.64
		CULATINGAN	515.73	1,020.68	76.03	343.82	1,122.75	57.02	2.67	5.72
		DUNGAN	47.31	182.69	49.76	0.00	243.59	0.00	0.00	0.79
		GREEN VILLAGE	2,161.43	28.29	252.22	3,242.15	34.71	343.93	0.51	0.64
		LILIBANGAN	34.57	48.43	0.00	51.85	61.88	0.00	0.65	1.55
		MAGAO	60.17	162.61	1.63	75.22	251.31	2.17	3.44	6.77
		MALUPA	327.40	182.82	0.00	245.55	206.67	0.00	0.45	0.97
		MINANE	2,399.33	282.77	1,490.59	2,056.57	307.58	1,355.08	1.97	2.83
		PANALICSICAN	1,120.95	4,100.08	2,462.28	1,324.75	4,631.57	2,462.28	6.31	9.26
		SAN ANTONIO	1,802.45	911.07	267.45	1,966.31	1,150.83	267.45	1.75	3.32
		SAN BARTOLOME	1,555.73	1,230.43	1,291.36	2,178.02	1,922.55	1,452.78	0.88	3.85
		SAN FRANCISCO	4,456.56	1,118.20	861.85	3,183.26	1,366.69	775.66	1.13	2.85
		SAN ISIDRO	2,074.02	2,032.23	2,406.28	2,074.02	2,570.17	2,105.50	2.19	5.73
		SAN JOSE (POB.)	14,370.02	205.26	211.40	20,248.66	255.52	256.69	0.36	0.56
		SAN MARTIN	1.46	1.55	0.01	2.19	1.97	0.01	0.40	0.68
		SAN NICOLAS (POB.)	6,608.16	18.86	494.71	5,286.52	20.74	395.77	0.17	0.41
		SAN NICOLAS BALAS	1,380.59	552.00	1,506.34	2,991.27	897.00	2,410.15	1.37	5.69
		SAN VICENTE	129.44	29.63	36.84	110.95	45.43	36.84	0.00	1.15
		STA. MONICA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
		STA. RITA	212.51	21.59	49.09	188.90	25.19	40.90	0.70	1.28
		STO. CRISTO	104.26	34.84	30.82	104.26	52.27	30.82	0.01	0.11
		TALIM MARIMLA	200.05	469.31	0.00	244.51	553.79	0.00	2.32	4.00
		TALIM SAN MIGUEL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
		TELABANCA	74.57	27.36	228.72	125.58	35.18	381.19	4.09	7.76
	CONCEPCION		41,855.09	17,955.12	11,765.56	48,590.48	22,598.11	12,423.24	48.28	88.13
			58,457.29	23,240.43	21,047.18	68,206.77	30,786.35	21,803.23	58.16	134.06

Table A.2.24 Probable Flood/Mudflow Damage by Return Period in Abacan River Page (1/2)

Abacan River System			Flood Damages by Return Period (x1000 pesos)			Flood Damages by Return Period (x1000 pesos)			Flood Damages by Return Period (x1000 pesos)		
			2 years			5 years			10 years		
Province	Municipality	Barangay	Buildings	Land	Infra-structure	Buildings	Land	Infra-structure	Buildings	Land	Infra-structure
PAMPANGA	ANGELES CITY	CAPAYA	7,302.30	0.00	1,133.69	8,309.51	0.00	1,330.86	8,309.51	0.00	1,380.15
		PANDAN	13,870.62	0.00	765.06	13,140.58	0.00	714.06	10,220.45	0.00	484.54
		PULONG MARAGUL	4,162.80	0.00	1,686.39	4,757.49	0.00	1,686.39	4,757.49	0.00	1,686.39
		SALAPUNGAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		SAPALIBUTAD	1,846.34	0.00	548.70	2,051.49	0.00	640.15	2,051.49	0.00	731.60
		TABUN	4,081.66	0.00	3,512.15	4,285.75	0.00	3,911.26	4,421.80	0.00	4,150.73
	ANGELES		31,263.72	0.00	7,645.99	32,544.82	0.00	8,282.71	29,760.75	0.00	8,433.40
	ARAYAT	ARENAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		LACMIT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		SAN ANTONIO	442.17	248.38	276.68	442.17	275.98	276.68	589.56	275.98	276.68
	ARAYAT		442.17	248.38	276.68	442.17	275.98	276.68	589.56	275.98	276.68
	MEXICO	ANAO	2,923.96	0.00	420.25	3,077.85	0.00	420.25	3,693.42	0.00	525.31
		BALAS	64.93	12.98	23.84	81.16	15.58	28.61	81.16	15.58	28.61
		BUENAVISTA	244.84	110.79	20.31	306.05	118.71	27.07	489.69	134.53	33.84
		CAMUNING	0.00	0.00	0.00	0.00	0.00	0.00	95.37	0.00	0.00
		CAWAYAN	1,053.69	0.00	335.78	1,164.61	0.00	363.76	1,330.98	0.00	419.73
		CONCEPCION	505.57	37.08	0.00	126.39	14.26	0.00	631.97	37.08	0.00
		CULUBASA	1,089.60	0.00	8.39	1,290.32	0.00	9.99	1,433.69	0.00	12.39
		DIVISORIA	115.66	134.68	155.12	115.66	134.68	155.12	115.66	134.68	155.12
		DOLORES (PIRING)	0.00	10.06	0.00	0.00	10.06	0.00	0.00	10.06	0.00
		EDEN	173.71	0.00	100.64	208.45	0.00	100.64	208.45	0.00	134.19
		GANDUS	35.93	0.00	116.05	71.86	0.00	116.05	71.86	0.00	232.10
		LAGUNDI	3,354.61	905.26	241.87	3,594.23	905.26	241.87	4,313.07	946.40	295.61
		LAPUT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		LAUG	884.34	244.60	78.72	884.34	244.60	78.72	884.34	244.60	78.72
		MASAMAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		MASANGSANG	4,746.64	1,021.35	2,635.44	5,111.76	1,038.10	2,811.14	6,024.58	1,071.58	3,162.53
		PANGATLAN	1,537.68	133.24	1,196.31	1,537.68	136.20	1,196.31	1,643.72	139.16	1,322.24
		PARIAN (POB.)	6,076.65	167.52	0.00	7,595.81	167.52	0.00	6,583.04	170.51	0.00
		SABANILLA	622.67	148.48	0.00	800.57	156.73	0.00	711.62	148.48	0.00
		SAN ANTONIO	2,208.91	56.15	0.00	2,208.91	59.55	0.00	2,208.91	61.25	0.00
		SAN CARLOS	7,465.38	418.01	0.00	9,379.58	456.60	0.00	7,848.22	430.87	0.00
		SAN JOSE MALINO	6,396.90	458.30	750.97	6,141.03	437.47	750.97	7,676.29	499.96	858.26
		SAN JOSE MATULID	1,842.98	562.04	768.49	2,211.58	576.46	845.34	2,703.04	605.28	1,152.74
		SAN JUAN	1,231.22	72.15	0.00	1,026.02	60.12	0.00	1,231.22	68.14	0.00
		SAN ROQUE	271.36	201.61	44.00	271.36	201.61	44.00	271.36	201.61	44.00
		SAN VICENTE	2,395.09	439.41	0.00	2,947.80	490.11	0.00	2,579.33	456.31	0.00
		STA. CRUZ	563.83	225.72	271.38	644.37	241.85	271.38	563.83	225.72	271.38
		STA. MARIA	1,285.20	480.56	49.15	1,285.20	520.60	49.15	1,285.20	520.60	49.15
		STO. DOMINGO	1,258.43	413.47	327.36	1,398.25	441.99	327.36	1,258.43	427.73	327.36
		STO. ROSARIO	67.12	19.36	2.65	82.03	20.38	3.18	74.57	19.36	2.65
		SUCLABAN	541.40	0.00	4.24	601.56	0.00	4.95	741.92	0.00	6.13
		TANGLAY (TANGLE)	872.32	0.00	0.00	1,055.97	0.00	0.00	1,285.52	0.00	0.00
	MEXICO		49,830.61	6,272.83	7,550.97	55,220.39	6,448.42	7,845.87	58,040.44	6,569.52	9,112.05
	SANTA ANA	SAN AGUSTIN	875.37	430.80	291.14	962.90	454.73	291.14	787.83	430.80	291.14
		SAN BARTOLOME	2,817.53	796.04	0.00	3,142.63	812.63	0.00	3,792.83	895.55	0.00
		SAN ISIDRO	1,414.23	300.32	4.99	1,414.23	325.35	6.65	1,767.79	350.38	6.65
		SAN JOAQUIN (POB.)	7,396.63	481.88	71.50	8,013.02	523.79	77.00	9,245.79	576.17	88.00
		SAN JUAN	1,666.48	355.91	24.00	1,309.37	287.03	20.57	1,785.51	344.43	27.43
		SAN PABLO	4,525.74	1,085.43	766.86	5,028.60	1,138.38	830.77	6,034.32	1,217.80	958.58
		SAN PEDRO	277.44	117.31	49.73	138.72	78.21	24.86	138.72	78.21	24.86
		SAN ROQUE	1,988.10	1,104.66	702.55	2,221.99	1,132.28	766.42	3,742.30	1,325.59	1,788.32
		SANTIAGO	3,879.39	1,127.13	0.00	3,879.39	1,079.17	0.00	4,696.11	1,223.06	0.00
		SANTO ROSARIO	15,812.45	1,275.71	374.86	13,835.89	1,275.71	340.78	14,824.17	1,369.06	374.86
	SANTA ANA		40,653.35	7,075.21	2,285.63	39,946.75	7,107.27	2,358.20	46,815.36	7,811.04	3,559.83
	Total		122,189.85	13,596.41	17,759.27	128,154.13	13,831.67	18,763.46	135,206.10	14,656.53	21,381.96

Table A.2.24 Probable Flood/Mudflow Damage by Return Period in Abacan River Page (2/2)

Abacan River System			Flood Damages by Return Period (x1000 pesos)			Flood Damages by Return Period (x1000 pesos)			Flood Damages by Return Period (x1000 pesos)			Affected Area (sq.km)	
			20 years			50 years			100 years				
Province	Municipality	Barangay	Buildings	Land	Infra-structure	Buildings	Land	Infra-structure	Buildings	Land	Infra-structure	20 years	100 years
PAMPANGA	ANGELES CITY	CAPAYA	7,805.90	0.00	1,330.86	7,805.90	0.00	1,330.86	8,057.71	0.00	1,281.57	0.24	0.66
		PANDAN	11,680.52	0.00	561.04	12,045.54	0.00	535.54	16,790.75	0.00	739.56	0.17	0.70
		PULONG MARAGUL	4,757.49	0.00	1,686.39	5,946.86	0.00	1,967.46	7,730.92	0.00	2,248.52	0.32	0.68
		SALAPUNGAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
		SAPALIBUTAD	2,666.94	0.00	914.50	3,692.68	0.00	1,097.40	3,487.54	0.00	1,005.95	0.36	0.78
		TABUN	4,625.88	0.00	4,230.55	4,761.94	0.00	4,390.19	5,238.13	0.00	4,948.94	0.76	1.01
	ANGELES		31,536.73	0.00	8,723.33	34,252.92	0.00	9,321.44	41,305.04	0.00	10,224.53	1.85	3.90
	ARAYAT	ARENAS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.88	0.00	0.00	0.09
		LACMIT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
		SAN ANTONIO	589.56	275.98	276.68	442.17	248.38	276.68	1,031.73	524.36	368.91	0.05	1.47
	ARAYAT		589.56	275.98	276.68	442.17	248.38	276.68	1,031.73	545.24	368.91	0.05	1.66
	MEXICO	ANAO	3,539.53	0.00	490.29	3,231.74	0.00	455.27	5,232.35	0.00	735.44	0.58	0.90
		BALAS	73.05	13.85	23.84	129.86	21.64	42.91	113.63	22.50	33.38	0.01	0.46
		BUENAVISTA	489.69	134.53	33.84	795.74	166.19	60.92	612.11	182.01	54.15	0.69	1.35
		CAMUNING	95.37	0.00	0.00	0.00	0.00	0.00	286.11	0.00	148.29	0.00	0.08
		CAWAYAN	1,608.27	0.00	475.69	1,774.64	0.00	587.62	2,383.79	0.00	1,007.34	1.36	2.81
		CONCEPCION	631.97	39.93	0.00	126.39	14.26	0.00	189.59	17.11	0.00	0.00	0.10
		CULUBASA	1,749.10	0.00	15.19	1,806.45	0.00	17.19	2,093.19	0.00	23.58	0.66	1.27
		DIVISORIA	115.66	149.64	155.12	231.32	194.53	232.69	173.49	224.46	155.12	0.19	0.59
		DOLORES (PIRING)	0.00	10.06	0.00	0.00	10.06	0.00	0.00	10.06	0.00	0.00	0.22
		EDEN	243.19	0.00	134.19	243.19	0.00	134.19	312.67	0.00	167.73	0.00	0.24
		GANDUS	71.86	0.00	232.10	71.86	0.00	116.05	71.86	0.00	116.05	0.00	0.09
		LAGUNDI	4,792.30	1,008.13	322.49	9,105.37	1,316.73	644.98	5,031.92	1,049.27	322.49	1.75	2.15
		LAPUT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22
		LAUG	884.34	244.60	78.72	884.34	270.35	78.72	884.34	476.34	78.72	0.02	1.16
		MASAMAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
		MASANGSANG	7,667.65	1,172.04	5,270.88	13,509.66	1,473.43	11,947.32	11,866.60	1,389.71	9,838.97	2.48	2.71
		PANGATLAN	1,696.74	148.05	1,259.28	2,545.12	189.50	2,203.73	2,014.88	183.58	1,574.09	2.26	4.50
		PARIAN (POB.)	6,076.65	170.51	0.00	16,710.79	236.33	0.00	13,166.08	188.46	0.00	0.37	0.37
		SABANILLA	711.62	156.73	0.00	2,134.86	263.97	0.00	978.48	197.98	0.00	0.24	0.54
		SAN ANTONIO	2,208.91	66.36	0.00	2,485.02	79.97	0.00	2,485.02	86.78	0.00	0.12	0.23
		SAN CARLOS	7,656.80	437.30	0.00	16,844.96	604.51	0.00	17,610.64	610.94	0.00	0.66	0.84
		SAN JOSE MALINO	9,211.54	572.87	1,019.18	6,652.78	489.55	750.97	6,396.90	583.29	804.61	0.31	1.67
		SAN JOSE MATULID	3,194.50	677.34	1,690.68	4,546.03	821.45	2,459.17	4,300.29	850.27	1,998.08	0.95	1.75
		SAN JUAN	1,641.62	88.18	0.00	615.61	48.10	0.00	1,128.62	84.17	0.00	0.00	0.16
		SAN ROQUE	217.09	213.47	44.00	271.36	249.05	44.00	271.36	284.63	44.00	0.29	0.58
		SAN VICENTE	2,579.33	456.31	0.00	4,237.46	608.41	0.00	3,316.28	709.81	0.00	0.00	1.51
		STA. CRUZ	644.37	257.97	271.38	1,127.65	338.58	434.20	724.92	386.95	271.38	0.00	1.08
		STA. MARIA	1,285.20	574.00	49.15	1,445.85	640.74	49.15	1,285.20	680.79	49.15	1.01	1.46
		STO. DOMINGO	1,538.08	484.76	368.28	1,538.08	570.31	368.28	1,677.90	741.40	368.28	0.36	1.75
		STO. ROSARIO	74.57	20.38	3.18	156.61	26.49	8.49	164.06	27.51	10.08	0.79	0.98
		SUCLABAN	882.28	0.00	7.07	862.23	0.00	6.84	1,062.75	0.00	8.72	1.45	2.33
		TANGLAY (TANGLE)	1,285.52	0.00	0.00	1,515.08	0.00	0.00	1,377.35	0.00	0.00	0.84	1.25
	MEXICO		62,866.79	7,097.01	11,944.55	95,600.04	8,634.14	20,642.68	87,712.36	8,988.03	17,809.65	17.39	35.41
	SANTA ANA	SAN AGUSTIN	875.37	454.73	339.67	1,663.20	646.20	776.38	1,050.44	646.20	339.67	0.35	2.13
		SAN BARTOLOME	4,443.03	1,011.64	0.00	3,251.00	948.30	0.00	5,743.42	1,227.23	0.00	0.66	1.66
		SAN ISIDRO	1,767.79	375.40	6.65	1,060.67	325.35	4.99	2,121.35	600.64	6.65	0.18	0.94
		SAN JOAQUIN (POB.)	10,170.37	639.02	99.00	8,937.60	628.54	88.00	12,944.11	838.06	121.00	0.83	1.87
		SAN JUAN	1,071.31	275.55	20.57	2,023.58	424.80	30.85	2,142.61	459.24	30.85	0.14	0.64
		SAN PABLO	6,788.61	1,323.70	1,086.39	5,280.03	1,297.22	830.77	10,057.20	1,614.91	2,044.97	2.06	3.09
		SAN PEDRO	277.44	130.35	49.73	138.72	91.24	24.86	208.08	117.31	24.86	0.01	0.19
		SAN ROQUE	4,560.93	1,436.06	2,171.53	2,455.89	1,297.98	894.16	3,625.35	1,601.76	1,277.37	2.27	3.96
		SANTIAGO	5,308.64	1,390.93	0.00	4,900.28	1,438.89	0.00	5,512.82	1,558.80	0.00	1.24	2.08
		SANTO ROSARIO	19,765.56	1,524.63	477.10	27,671.78	1,742.44	783.80	21,742.12	1,960.24	477.10	2.18	3.62
	SANTA ANA		55,029.04	8,562.00	4,250.62	57,382.74	8,837.96	3,433.81	65,147.49	10,624.39	4,322.46	9.92	20.18
	Total		150,022.12	15,934.99	25,195.18	187,677.88	17,720.48	33,674.61	195,196.62	20,157.66	32,725.56	29.21	61.15

FIGURES

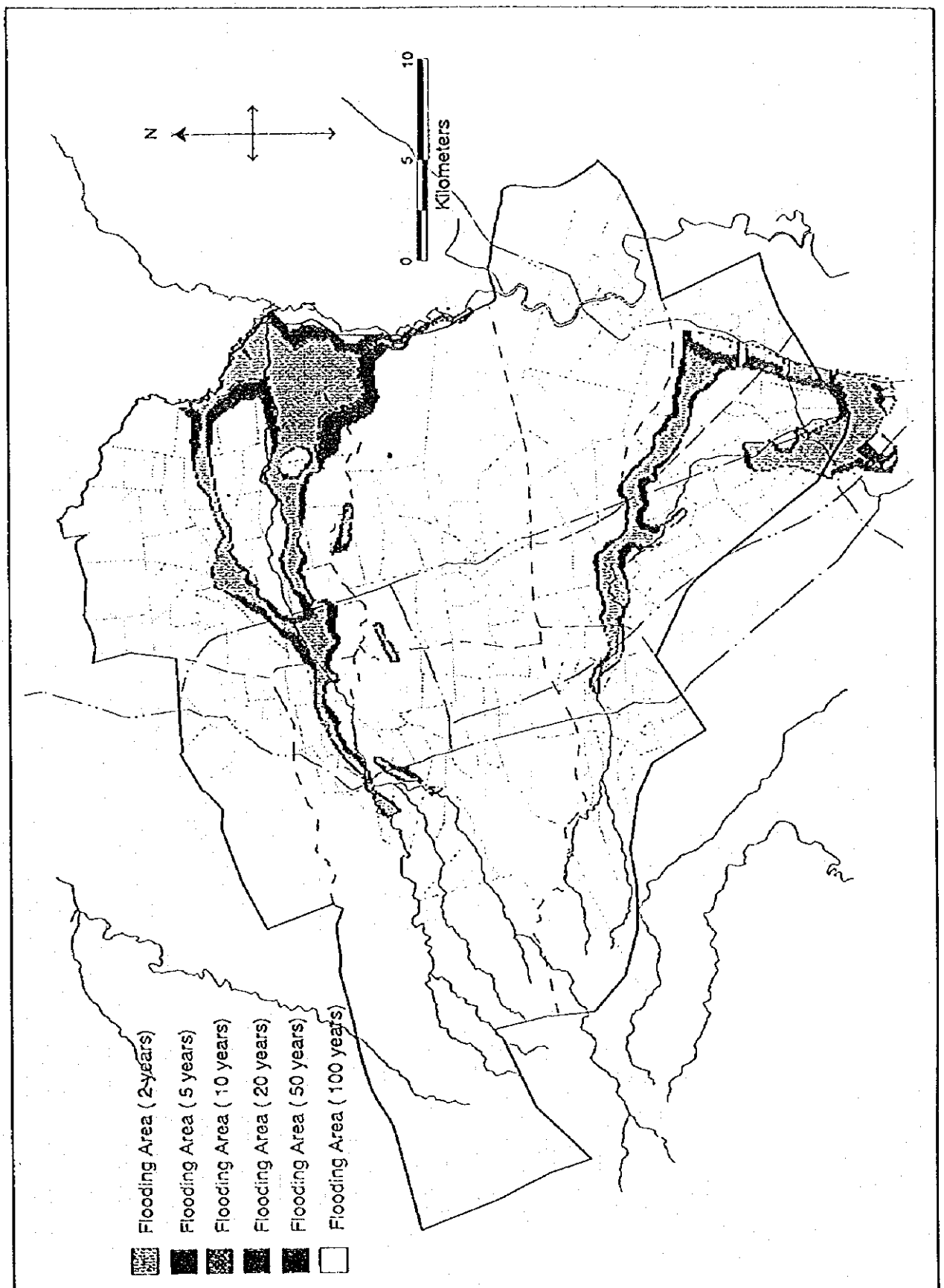
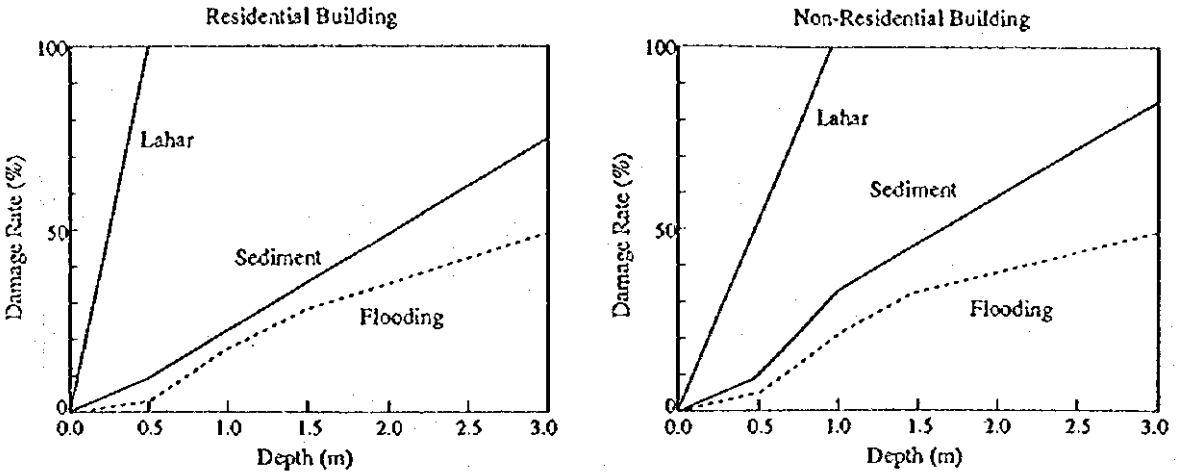


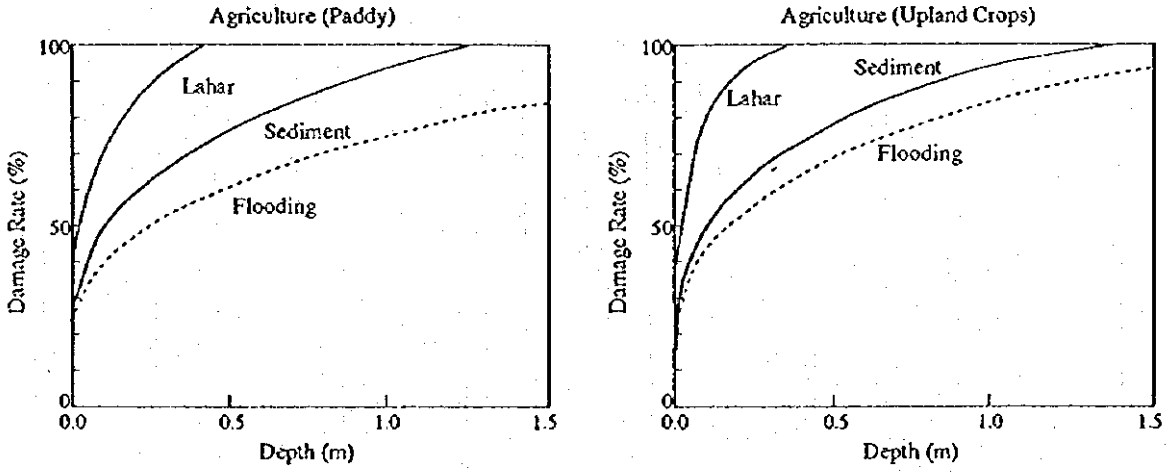
Figure A.2.1 Probable Inundation Area for each Return Period

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

Building



Agriculture



Infrastructure

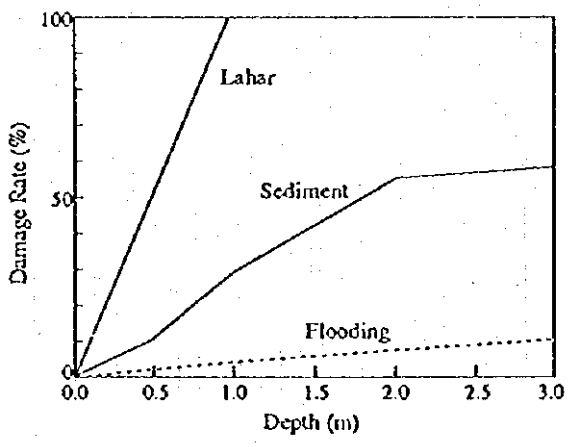


Figure A.2.2 Damage Curves for Properties

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

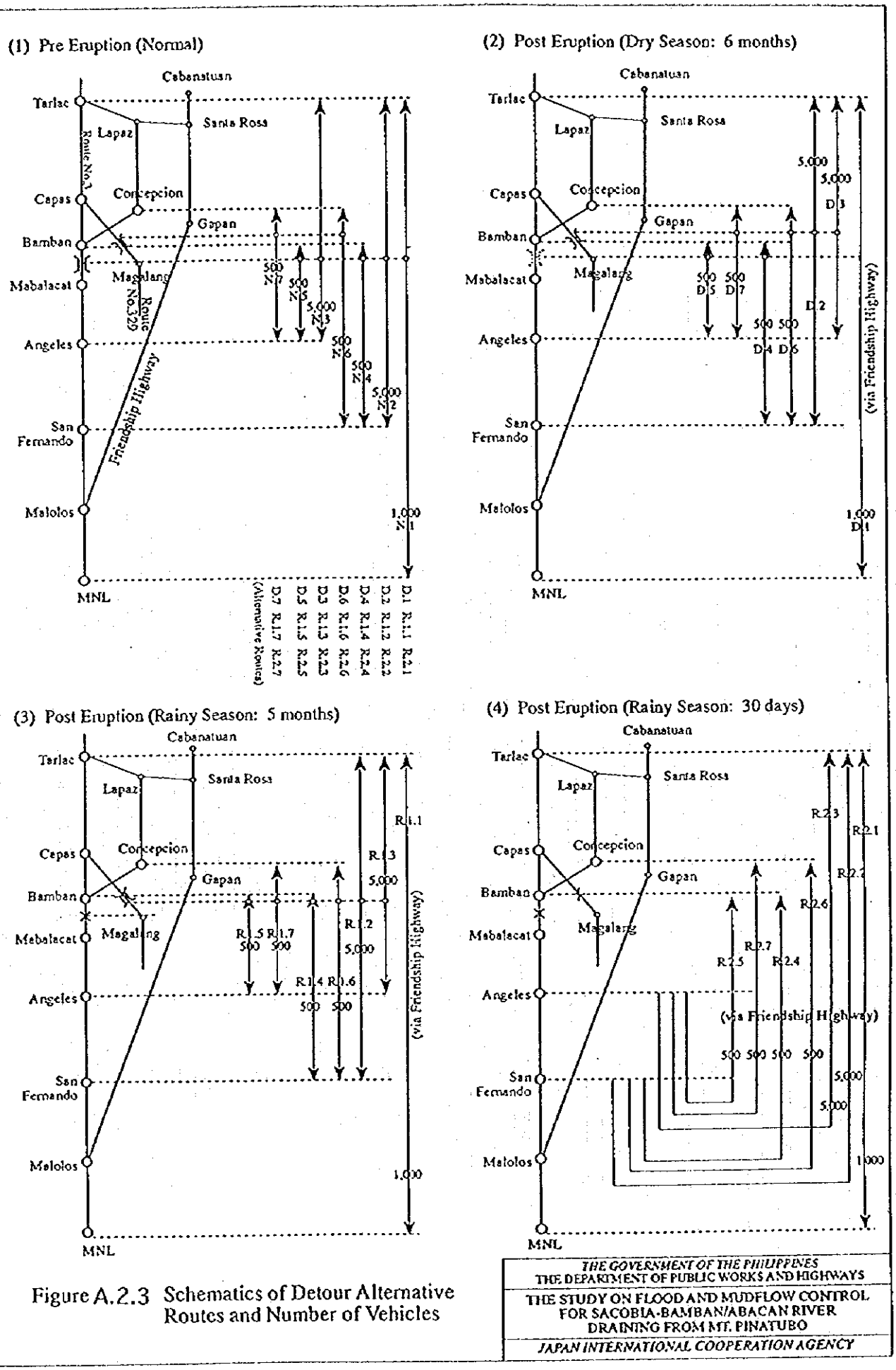


Figure A.2.3 Schematics of Detour Alternative Routes and Number of Vehicles

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

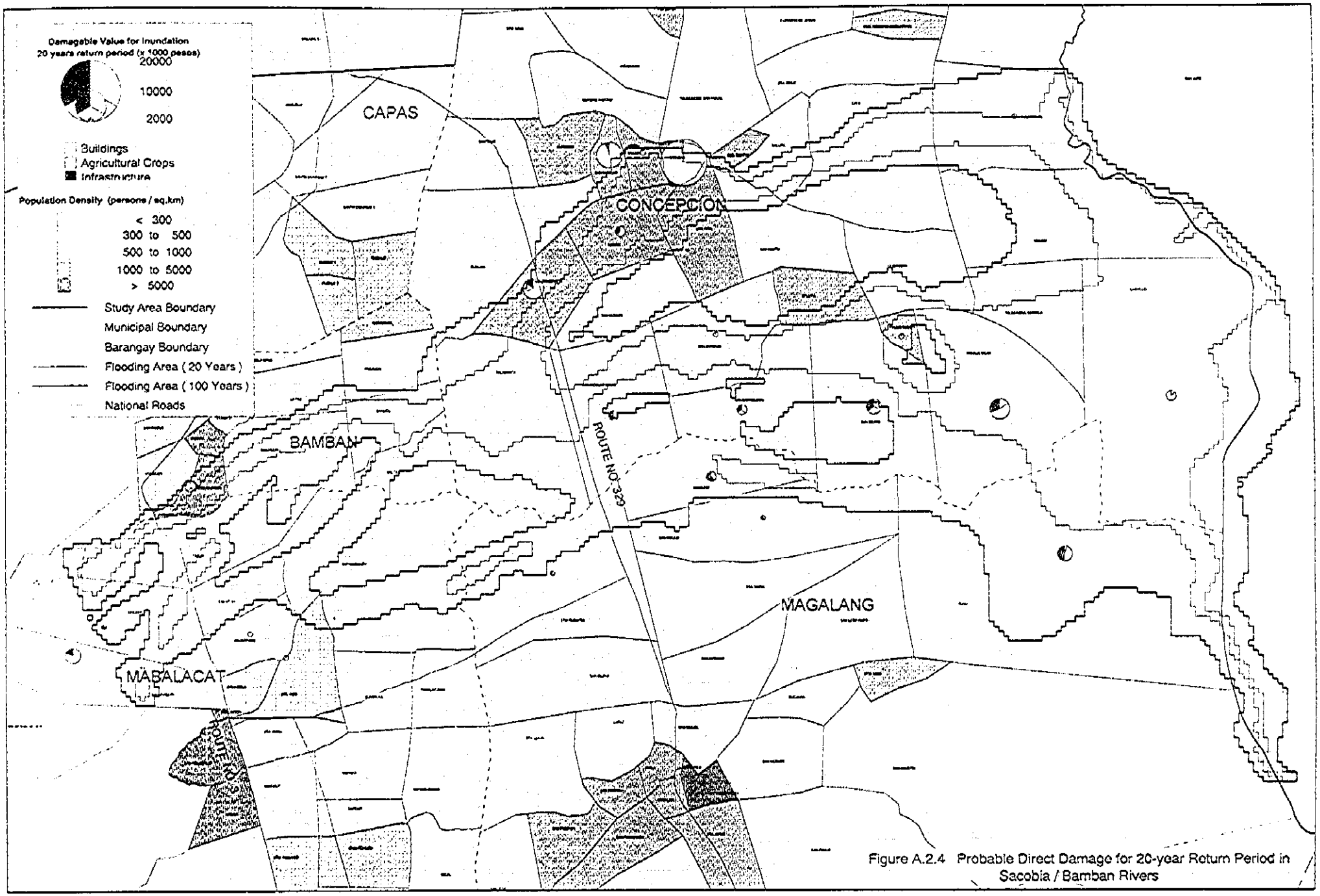


Figure A.2.4 Probable Direct Damage for 20-year Return Period in Sacobia / Bamban Rivers

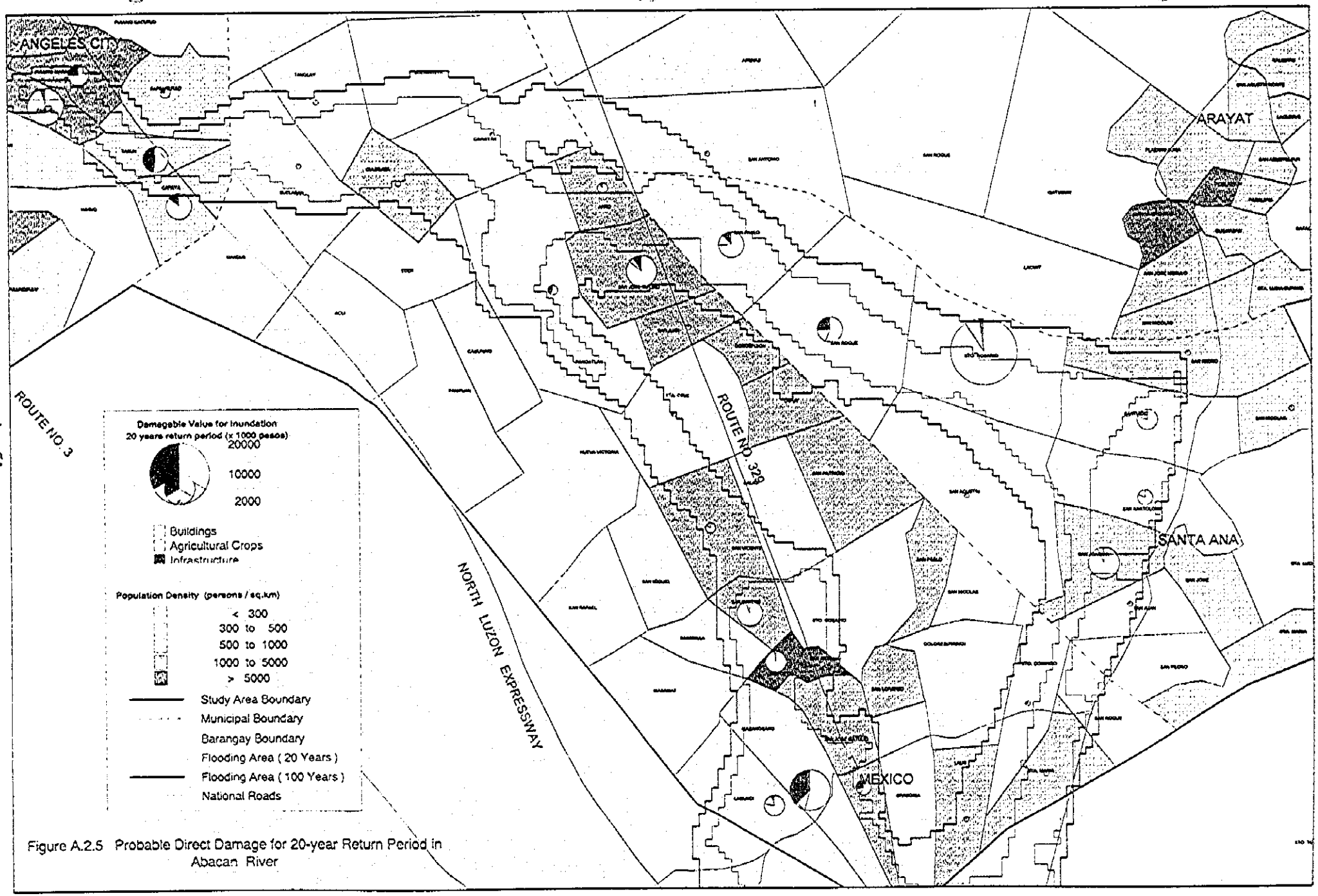


Figure A.2.5 Probable Direct Damage for 20-year Return Period in Abacan River

APPENDIX B

FLOOD/MUDFLOW DAMAGES

APPENDIX B

FLOOD/MUDFLOW DAMAGES

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B.1 EXTENT OF DAMAGE

This section provides information on the extent of flood and mudflow damage after the Mt. Pinatubo eruption, the estimated damage amount, and the method of damage calculation.

Available reports on lahar events from 1991 to 1993 have been collected from PHIVOLCS, a damage summary in Region wide from 1991 to 1992 has been prepared by the Presidential Task Force Mt. Pinatubo, available damage value in 241 barangays in the study area from 1991 to 1993 were obtained from 1 city and 8 municipalities. Figure 1-1 shows the barangay list, location and area of lahar deposits from 1991 to 1994.

Lahar in the 1994 affected areas described in the following subsection. Since the data are not completely available, the other damage values and amount are summed up for 3 years from 1991 to 1993.

Despite the fact that the actual affected areas belong to different administrative boundaries, the damage per city/municipality in the study area is distributed between the two river systems to compare with the statistics and to evaluate past damage. The municipalities of Bamban, Capas and Concepcion in Tarlac Province, and Mabalacat and Magalang in Pampanga Province are in the Sacobia-Bamban river basin, while Angeles City and the municipalities of Arayat, Mexico and Santa Ana in Pampanga Province are in the Abacan river basin (Figure 1-1).

Some damage data reported by barangays were not direct damage by lahar or flood from the two rivers, but include damage by silted creeks due to ashfall.

1.1 AFFECTED AREA

The eruption of Mt. Pinatubo on June 15, 1991 produced a remarkable volume of pyroclastic flow deposit that covered thousands of square kilometers and caused massive damage in Central Luzon. Pyroclastic-flow deposit was estimated at about 7 km^3 on the slopes of Mt. Pinatubo. Areas within the 10-40 km radius danger zone of the volcano bore the brunt of heavy ashfall blown all over the archipelago. Pyroclastic flow deposit, lahar deposit as of 1991 and isopack line of ashfall are as shown in Figure 1-2.

The lahar deposit areas in the Sacobia-Bamban and Abacan river systems for the period from 1991 to 1994 are as shown in Figures 1-3 and 1-4. The table below shows the lahar covered areas in 1991 - 1994, where those of 1992 - 1994 show additionally covered areas for comparison with the previous year. The additional lahar deposit area in 1993 and 1994 in the Sacobia-Bamban river system was measured by the JICA Study Team from the map of lahar deposit area prepared by PHIVOLCS and the site survey conducted on November 1994. The actual affected area is not known because it is difficult to distinguish the additional lahar deposit area by using Landsat images or aerophotographs if the area has been once covered by lahar. The lahar deposit area is estimated at 11,693 ha for the Sacobia-Bamban river system and 2,930 ha for the Abacan river system in 1994. Of the additional 1994 lahar deposit area, 86% are paddy fields and the remaining 14% are grassland. On the other hand, the lahar deposit area in Region wide in 1991-1992 was 35,940 ha and the total of 29% in Sacobia-Bamban river system and the total of 8% in Abacan river system.

Lahar Deposit Area

(Unit: ha)

River System	covered by 1991	additional 1992	additional 1993	additional 1994	Total
Sacobia-Bamban	8,125	2,183	1,267	118	11,693
Abacan	2,930	0	0	0	2,930
Study Area Sub-Total	11,055	2,183	1,267	118	14,623
Bucao-Balin	5,375	0	-	-	5,375
Maloma	1,825	0	-	-	1,825
O'Donnell-Bangot	3,347	0	-	-	3,347
Pasig-Potrero	3,869	503	-	-	4,372
Porac-Gumain	3,141	0	-	-	3,141
Sto. Tomas	4,643	0	-	-	4,643
Regional Total	33,255	2,686	-	-	37,326

1.2 LAHAR EVENTS

Based on PHIVOLCS' reports, lahar events in the study area since 1991 had occurred as below:

(1) In 1991 (Ref. 1)

On the Sacobia-Bamban river, lahar flow began occurring in June 14, and some barangays in Conception were hit on the same day. Damming of the Marimla river and other tributary valleys by aggrading the Sacobia river channel has led to intermittent formation of lakes, one of which was breached and added to the lahar that destroyed the Route 3 Bamban river bridge in August 21. Flood protection dikes along the Bamban river were first breached by lateral erosion or overtopping of lahar in June 15, and sediment continued to be widely dispersed on both sides of the channel until early September. Deposits are estimated to average 2.0 m thick over much of the lower fan, and the average rate of lahar occurrence per day (late June to mid-September), was 0.83 and 3 to 5 events per day were common during the rainiest period.

On the Abacan river, the first major lahar flow occurred in June 15. Lahar events after the 1991 monsoon season, more than 40 in all, destroyed or damaged all of the bridges across the Abacan river upstream of Mexico and caused bank collapse that destroyed hundreds of buildings in Angeles City.

The volume of lahar deposit on the Sacobia-Bamban and Abacan river basins in 1991 was estimated at about 160 million m^3 (Ref 2).

(2) In 1992 (Ref 3)

Along the Sacobia-Bamban river, moderate lahar flow occurred at barangays of Mabalacat, Bamban and Conception in June and July. Lahar events from August 28 to 30 buried the northern Bgy. Tabun of Mabalacat by 3-4 m, and parts of Bamban by 1-3 m. The stretch of Bamban river near the Route 3 Bamban river bridge was aggraded by 4.5 m of lahar and the bridge floor was covered by 0.5 m of deposits. The town of Bamban was also affected by flooding from the Marimla river which was dammed by lahar from the Sacobia river. On September 3 to 5, lahar flow along the Sacobia-Bamban river destroyed the northeastern corner fence of Clark Air Base, and Bgy. Dolores was inundated by 2-4 m.

The volume of lahar deposit on the Sacobia-Bamban river basin was estimated at about 70 million m^3 in 1992 (Ref. 2).

(3) In 1993

On the Sacobia-Bamban river, the major lahar event in 1993 has been reported as follows. In October 4 to 5, by the passage of typhoon Kadiang at Bgy. Dolores, scouring occurred during the early part of the lahar flow in October 5 and portions of the gabion matting of the Mabalacat dike were destroyed. Flows resulted in 2.0-2.5m in channel deposition, and 2-3m thick deposition at Bgy. Sapang Balen (Ref. 5).

The volume of lahar deposit on Sacobia-Bamban river basins was estimated at about 45 million m3 in 1993 (Ref 5).

1.3 AFFECTED POPULATION AND HOUSEHOLDS

The total affected persons and families in Region wide has reached 2.3 million and 0.48 million in 1993, respectively. The first year counts for both persons and families affected constitute more than half (52%) of the total affected population and families.

In the study area, based on the damage data per barangay, the affected persons and families per municipality are summarized in Tables 1-1 and 1-2. The annual total affected persons and families by lahar and flood is the sum of the greater value of lahar or flood damage, as shown below. The total affected persons and families by lahar and flood in the study area has reached 187 thousand persons and 33 thousand families in 1993, respectively.

Affected Persons and Families by Lahar and Flood

Year	Sacobia-Bamban		Abacan		Region wide	
	Persons	Families	Persons	Families	Persons	Families
1991	28,191	4,827	34,299	7,273	1,180,132	249,371
1992	30,155	5,475	19,346	3,357	803,972	164,400
1993	38,604	6,712	37,186	6,046	314,905	66,456
Total	96,950	17,014	90,831	16,676	2,299,009	480,227

Source : MSWD, DSWD Region III

The affected persons by ashfall in the study area are assumed to be about 294 thousand persons corresponding to about 40% (average of Angeles, Mabalacat and Mexico) of the total population in the study area in 1990, because data from some municipalities were not available.

In the Sacobia-Bamban river system, the most affected by lahar were Bamban and Concepcion in 1991, Bamban and Mabalacat in 1992, and Concepcion in 1993. On the other hand, Magalang had increased damage by flood in 1992 and 1993.

In the Abacan river basin, damage caused by lahar flow directly from Abacan river was only in 1991. Almost all damage by lahar in 1992 and 1993 are considered to be silted creeks due to ashfall. In 1991, the most affected by lahar was Angeles and Mexico. On the other hand, Mexico, Santa Ana and Arayat had increased damage by flood in 1992 and 1993.

1.4 DAMAGE TO LIFE AND PROPERTY

Based on the disaster monitoring report in Region III and the damage data per barangay in the study area, casualties and damaged houses are summarized as follow.

(1) Casualties

In Region III, total casualty was reported as 1,182 persons by the end of 1993, and 97% of this count were casualties during the first year of the calamity. Of the total 934 deaths

in 1991, 31% were due to ashfall, 12% due to lahar, 2% due to flood and 55% succumbed to various ailments mostly in the evacuation centers.

Casualties in Region III

Year	Dead	Injured	Missing	Total
1991 (Ashfall and Lahar)	934	184	23	1,141
1992 (Flood and Lahar)	18	7	1	26
1993 (Lahar)	11	0	4	15
Total	963	191	28	1,182

Source: DSWD Region III and NDCC

In the study area, casualties have been reported in Angeles City, Mabalacat and Mexico as summarized in the following table.

Casualties in the Study Area

Year	Dead	Injured	Missing	Total
1991 (Ashfall and Lahar)	21	26	3	50
1992 (Lahar)	3	8	0	11
1993 (Lahar and Flood)	0	0	0	0
Total	24	34	3	61

Source : MSWD

In 1991, death caused by lahar were 17 persons by the first major lahar flow in June 15 along the Abacan river; 2 in Bgy. Amsic, 2 in Bgy. Pulong Maragul and 6 in Bgy. Sapang Bato in Angeles City, and 7 in Bgy. Culubasa in Mexico. The other death were caused by ashfall.

In 1992, death caused by lahar flow on September 3 to 5 along the Sacobia-Bamban river were 3 in Bgy. Dolores in Mabalacat.

(2) Damaged Houses

In Region III, a total of 123,621 houses were damaged in the period from 1991 to 1993. In 1992, a total of 3,072 partially damaged houses were due to flood, 1,428 (45%) houses of totally damaged houses were due to flood, and the remaining 55% of totally damaged houses were due to lahar.

Damaged Houses in Region III

Year	Totally	Partially	Total	
1991 (Ashfall and Lahar)	41,979	70,257	112,236	(91%)
1992 (Flood and Lahar)	3,140	3,072	6,212	(5%)
1993 (Lahar)	1,684	3,489	5,173	(4%)
Total	46,803	76,818	123,621	(100%)

Source: DSWD Region III

In the study area, based on the data per barangay, damaged houses are given in Table 1-3 and summarized below. Some of these data are not certain because of coincidence of affected families and damaged houses in Bamban and Santa Ana, which are considered to be evacuated families. A total of 22,378 houses were damaged in the period from 1991 to 1993. During this period, as the damage by lahar decreased in the study area, damage by flood increased, especially, in Santa Ana.

Damaged Houses by Lahar and Flood in the Study Area

Year	Sacobia-Bamban		Abacan		Total
	Totally	Partially	Totally	Partially	
1991	4,548	2,799	3,213	2,849	13,409
1992	3,872	1,186	107	1,180	6,345
1993	203	1,066	0	1,355	2,624
Total	8,623	5,051	3,320	5,384	22,378

Source : MSWD

Figure 1-5 presents the totally damaged houses by lahar in the study area. In Sacobia-Bamban river, totally damaged houses were 2,894 at both sides of the Bamban bridge and 1,624 at the downstream of San Francisco bridge in 1991; 3,469 at the expanded area damaged in 1991 at Bamban bridge and 400 at the upstream of San Francisco Bridge in 1992; and 200 along Route 329 and Bgy. Sapang Balen. Submerged houses due to the lahar-dammed lake of Sapang Cauayan river were counted at 162 houses on the JICA map with a scale of 1:10,000. In Abacan river, totally damaged houses were 1,524 in Bgy. Sapang Bato, 1,377 along the river in Angeles City, 210 at the downstream of Capaya bridge and 92 around Route 329 in Mexico in 1991, and 107 at the upstream of Abacan bridge in Angeles city in 1992.

1.5 DAMAGE TO INFRASTRUCTURE

In Region wide, infrastructure damage summarized from Mt. Pinatubo Rehabilitation and Reconstruction Program, and Mt. Pinatubo Rehabilitation Plan Program as shown in Table 1-4. On the other hand, in the study area, infrastructure damage per barangay was collected from each city/municipal office, and summarized per municipality in Table 1-5.

In Sacobia-Bamban river, route 3 including bridges linking Mabalacat and Bamban were destroyed and covered with lahar deposits. Bamban bridge was destroyed by lahar in 1991. San Francisco bridge and Route 329 is being threatened by lahar and flood.

In Abacan river, all the bridges across the Abacan river upstream of Mexico were damaged. These included 7 bridges and 2 spillways in Angeles City. Abacan national bridge was destroyed by lahar in 1991 and rebuilt in 1992. Abacan spillway in Bgy. Malabanias, Sapang Bato spillway and Pulung Maragul bridge were destroyed in 1991. The bridge which links Mexico to Arayat was elevated. Stream bank erosion of Abacan river in Angeles City destroyed residential houses and roads to Bgy. Sapang Bato along the perimeter of Clark Air Base. The breaching of the dike at Kapaya I, 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.

1.6 DAMAGE TO AGRICULTURAL LAND

In Region wide, based on the reports of DA III, agricultural land area affected by ashfall reached some 96,227 ha in 1991.

On the other hand, in the study area, Agricultural land damaged per barangay was collected from each city/municipality, and summarized per municipality in Table 1-6. According to the municipal agriculturists, almost all farmlands covered once by lahar became wasteland, and some farmers trying to grow watermelon or sugarcane at the sediment cropland. As mentioned above, Arayat and some barangays in Mabalacat and Magalang were not damaged by lahar directly from the two rivers. They seem to be silted creeks due to ashfall, but they were counted as damage by lahar.

In the Sacobia-Bamban river system, a total of 10,639 ha were damaged by lahar from 1991 to 1993; about 1,623 ha in Bamban in 1991, about 6,596 ha in Concepcion from 1991 to 1993, about 1,370 ha in Mabalacat from 1991 to 1993, about 1,013 ha in Magalang from 1992 to 1993, and about 39 ha in Capas in 1991.

In the Abacan river system, a total of 2,593 ha were damaged by lahar and sediment from 1991 to 1993; about 95 ha in Angeles city in 1991, about 288 ha in Arayat from 1991 to 1993, about 1,816 ha in Mexico in 1991 and 1993, and about 394 ha in Santa Ana in 1991.

B.2 DAMAGE AMOUNT

2.1 DAMAGE AMOUNT IN REGION WIDE

This section summarizes the damage in 1991 and 1992 based on reports and information gathered by the Presidential Task Force Mt. Pinatubo from government agencies or departments concerned. As of the end of this study period in the Philippines, damage in 1993 has only been partially reported by some government offices concerned, hence, final figures could not be incorporated in this report.

Damage in the first year due to the eruption of Mt. Pinatubo was estimated at ₱10,570 million, in which damage to military facilities was estimated at ₱3,842 million, public infrastructure at ₱3,830 million, agriculture at ₱1,927 million, trade and industry at ₱851 million and natural resources at ₱120 million in order of magnitude (Ref. 6). In the second year, the total damage has increased to at least ₱11,700 million (Ref. 7).

(1) Infrastructure

Damage to public infrastructure was estimated at ₱3,832 million as of 1991 (refer to Table 6.4), and ₱453 million in 1992; thus, public infrastructure suffered from the heaviest damage with a total estimated damage of around ₱4,280 million in the two-year period of the disaster.

Damage to Pampanga, Tarlac and Angeles City in the eastern areas was ₱736 million (19.21%) as of 1991, i.e., ₱329 million (8.6%) and ₱632 million (16.51%), respectively. The worst destruction was on roads and bridges, and flood control and drainage facilities.

These costs of damage were estimated as repairing, rehabilitation and reconstruction/ development cost.

1) Road and Bridges

About 489 km of major national roads and 163 km of municipal roads in Zambales, Pampanga, Bataan and Tarlac were covered with ash or sand, with thickness ranging from 5 to 30 cm during the first year calamity.

Immediately after the eruption, lahar flows collapsed six major bridges: the Abacan, the Panda, the Mancatian, the Pabanlag-Pampanga, the Santa Fe and the Umaya. Later, lahar flows caused the destruction of the Bamban bridge in Tarlac and a portion of the Capaya bridge along the North Expressway in Angeles City, and inundated two bridges along the Botolan-Capas Road in Botolan, Zambales. Approaches to several bridges were also damaged. All in all, 13 major bridges were damaged.

Damage to roads and bridges was estimated at ₱1,065 million in 1991 and ₱309 million in 1992.

2) Railway Facilities

Damage to railway facilities was reported only in 1991. Spans of four railway bridges were washed away by cascading lahar flows. Two were situated

between Angeles and Dau, while the other two were located between Mabalacat and Bamban. The estimated cost of damage was ₱70 million.

3) Airport Facilities

Two airports in Iba and Castillejos, both in Zambales, were affected by ashfall in 1991 making them unsafe for aircraft operations. The estimated cost of damage was ₱15 million.

4) Communication Facilities

Damage to telecommunication and postal communication facilities was reported also only in 1991 at ₱13.2 million. Damage came from 10 telegraph stations in Zambales, 13 in Pampanga and 3 in Tarlac varying from collapse of building structures to damage of telecommunication, office equipment and telephone lines.

5) Power and Electric Facilities

About 302 km of primary and secondary distribution lines were affected, while a total of 6,040 household consumers experienced service interruptions. A total of 294 units of distribution transformers of assorted capacity were also destroyed and 11,794 pieces of kwh meters are apt for replacement. Damage to power and electric facilities was reported only for 1991 in the amount of ₱55 million.

6) Water Supply Facilities

Water district facilities and equipment in 19 areas of the region were heavily affected. They include the cities of Angeles and Olongapo, six municipalities in Zambales, seven in Pampanga, two in Bataan, and two in Tarlac. Total damage was reported in 1991 at ₱123 million.

7) Irrigation Facilities

Five national irrigation systems covering some 24,839 ha were affected. In the first year, some 176 communal irrigation systems were also damaged, composed of 23,485 ha for a total of 48,324 ha and 25,476 affected farmers. Damage included heavy siltation on irrigation facilities caused by deposition of ash or sand, and the destruction of vegetation. Damage cost was estimated at ₱184 million in 1991.

8) School and Other Public Buildings

A total of 659 elementary, 24 secondary and 2 tertiary schools, consisting of some 4,665 classrooms were heavily affected in 1991 at an estimated rehabilitation cost of ₱748 million. Total damage in 1992 was reported at ₱3 million.

Health facilities affected include 140 buildings, 21 hospital structures, 38 main health centers, 74 barangay health stations and 7 other DOH building facilities at an estimated cost of ₱70.7 million reported in 1991.

Other damaged building structures during the first year of the disaster include 20 public markets, 16 municipal buildings, 10 slaughterhouses and 46 other public buildings with a total rehabilitation cost of ₱226.9 million.

(2) Agriculture

Agricultural land area affected by ashfall reached some 96,000 ha in 1991. Value of damage to crops, livestock and fisheries was estimated at about ₱1,474 million in 1991 and ₱778 million in 1992 (refer to Table 2-2).

In the first year of the calamity, the total area of riceland covered with ash or sand was 67,784 ha, approximately 21,585 ha of which were adversely affected with an estimated standing value loss in terms of crops of ₱90.27 million. Total number of farmers affected in these areas was 45,982. Lahar affected ricelands in Pampanga and Tarlac was about 8,969 ha with the estimated value loss of ₱89.68 million.

Based on the DA Region III report of September 30, 1991, lahar flow affected 23,063 ha of agricultural land. It should be noted that damage to about 5,467 ha of these affected areas was by ashfall. About 20,421 ha of the lahar affected areas were planted to rice and about 2,632 were fishponds. The cost of lahar affected agricultural land area was estimated at ₱453.174 million.

These damage costs are estimated as the product of the total area damaged and expected yield per hectare. Expected yield is estimated by referring to pre-calamity yield. Post-calamity yield is derived by referring pre-calamity yield subjecting the damaged crops to recovery chances/percentages. the value of crops with negative chances are derived by multiplying them with the prevailing market prices of the crops.

(3) Trade and Industry

In the trade and industry sector, the most heavily damaged was the manufacturing subsector and consequently the exporting subsector. A total of 599 firms were affected and the total of ₱850.6 million of assets was lost in 1991.

Forgone production losses were reported to be about 45% of the potential sales for 1991 or ₱453.7 million, while destroyed capital investments of the 306 affected firms surveyed stood at a total of ₱424.74 million. The hardest hit among the manufacturing sectors was the furniture industry with a total estimated damage of ₱156.5 million and 108 firms affected, followed by the processed food sector with ₱97.0 million (18 firms), gifts, toys and housewares (GTH), ₱60.34 million (92 firms).

For the second year of the calamity, the manufacturing subsector continued to account for the largest damage with the monthly forgone income on sales estimated at ₱1,524 million per month, followed by the wholesale and retail subsector with ₱846 million estimated losses. The remaining forgone income accounted by financing institutions and real estate or business services was estimated at about ₱636,325, Transportation, storage and communication accounted for ₱64,938, and construction, ₱52,689.

(4) Natural Resources

Some 18,000 ha of forest land were buried in ashfall of about 25 cm thick. The heavy concentration of ashfall was in the mountain ranges of Botolan and San Marcelino in Zambales, Porac and Floridablanca in Pampanga, and Bamban in Tarlac.

Reforestation activities have been seriously setback in the Zambales mountain range. Approximately 12,965 ha of newly established plantations were destroyed by the ashfall and some ₱120 million worth or 5,115,324 seedlings were lost as national forest covers, and old plantation damage extends to around 43,801 ha.

(5) Military Facilities

Damage to military facilities was reported only for the first year in the amount of ₱3,842 million.

2.2 *ESTIMATION PROCEDURE OF FLOOD AND MUDFLOW DAMAGE*

This section describes the procedure and method of estimation of Flood and Mudflow (FM) damage.

The purpose of damage estimation is not only to calculate damage potential in monetary term under the with- and without- FM control works under the present condition vis-a-vis the future, but also to discuss the potential hazard area by combining the results of numerical lahar simulation with socio-economic data under the condition with or without the sabo structures to be proposed in the master plan.

FM damages will be calculated with the Geographic Information System (GIS) by: basin and administrative unit under present and future conditions. The GIS database is composed of several input files including social capital data, digitized topographical map, land use, population, results of simulation which will be calculated by numerical mudflow simulation model, unit value of each item, and damage rates required. A partial flow of estimation procedure of FM damages is presented in Figure 2-1.

2.2.1 Classification of Damage by Flood and Mudflow

Generally, damages due to flooding and sediment are classified into three types, direct damage, indirect damage, and intangible damage.

Direct damage consists of losses of social capital such as existing public and private buildings, agricultural products, and infrastructure assets. Indirect damage is expenses of emergency activities and loss due to suspension of business activity. On the other hand, intangible damage is loss of life, psychological stress of people concerned and so forth, which is not quantifiable. Thus, this study analyzes direct damage and indirect damage. The constitution of damage losses is illustrated in Figure 2-2.

Taking the situation of the study area into consideration, the FM damage will be estimated under the following items:

(1) Direct Damage

1) Damage to buildings is divided into three types; (i) residential building including household effects, (ii) non-residential or public buildings including inventory stocks, and (iii) commercial building including contents.

2) Agriculture in the study area specializes on rice, sugarcane, corn, and other upland crops. The agricultural damage will be estimated for the following items; irrigated and rainfed paddy, sugarcane, corn, and other crops (root and tree crops, vegetables).

3) From the social standpoint, damage to infrastructure consists of damage to physical infrastructure and social infrastructure. Physical infrastructure includes various existing structures such as roads and bridges, flood control structures, irrigation facility, and water and telecommunication utilities. Social infrastructures such as schools and hospitals are not included in this item but are included under the structures mentioned above.

(2) Indirect Damage

Indirect damage includes expenses for emergency activities such as evacuation and emergency clean-up cost, and loss due to suspension of business activity such as loss of productivity and extra cost due to transportation disruption, and desiltation cost for disposal of sediment if sediment event occurs.

2.2.2 Methodology of Damage Calculation

Direct damage is calculated in the concept of [Direct Damage] = [Unit Value] x [Quantity] x [Damage Rate]in each mesh.

The calculation method of indirect damage will be studied in detail in the next stage of this study.

(1) Unit Value

Table 2-3 shows the basic form of estimation and unit value of damageable property. The unit value shown in table is reviewed in detail by each item in the next stage of this study.

Economic value of all properties which will be vulnerable to FM damages is estimated as damageable value as mentioned below.

1) Building

The damageable value of building is the product of the construction cost of new structure, floor area, distribution ratio, and average depreciation ratio.

2) Agriculture

The degree of damage on crops varies from month to month, depending on the cropping pattern. Therefore, the annual average damageable value of crops per hectare will be applied, and this is estimated as an aggregate of the expected net income and accumulated expenditure for the production spent until the time when FM event takes place, where the event frequency and cultivated area in each month have to be taken into account, as shown in Table 6.7.

3) Infrastructure

The damageable value of infrastructure is obtained in the same concept as those of the structure.

(2) Quantity

A GIS overlay analysis is conducted to determine the number of each item by each mesh block in the study area. The quantity for each item will be given in the next stage of the study.

(3) Damage Rate

The damage rates for each item vulnerable to flood or sediment damage is determined in accordance with the inundation or sedimentation depth, on the basis of interview at the site, damage records in the past, and the technical standards for river and sabo works of the Ministry of Construction of Japan. Figure 6.6 shows the damage rates for direct damage by inundation or sedimentation level.

If the simulation result of mudflow model indicates both inundation depth and sediment deposition depth, damages for both events are calculated and compared, then, the annual damage is determined by the greater of the two.

2.3 Damage Amount in the Study Area

Damage amount by lahar and flood are estimated from the damage data per barangay and damage report per city/municipality. Damage amount by ashfall is not estimated because damaged properties are not the same in all municipalities, and damage degree and value are not available.

Total direct and indirect damage amount by lahar and flood in the study area are estimated at about ₱426 million in 1991, about ₱495 million in 1992 and about ₱313 million in 1993, or about ₱1,233 million in total in Sacobia-Bamban river system; about ₱364 million in 1991, about ₱92 million in 1992 and about ₱100 million in 1993, or about ₱556 million in total in Abacan river system, the method of estimation and damage amount by sector is described as follow.

(1) Direct Damage

Direct damage by lahar and flood are estimated for the following items: buildings, agricultural crops and infrastructure. Damaged public buildings such as school buildings, health facilities, LTO building and other public buildings are estimated for infrastructure. Commercial and industrial buildings were damaged by ashfall in Angeles City, forest lands were also buried in ashfall in Bamban.

1) Damaged House

The amount of damage to houses is estimated as totally destroyed houses by lahar and flood. Unit value of house including household effects is estimated from the product of average construction cost and average depreciation ratio. Annual damage amount is estimated as the sum of the greater value of lahar or flood damage in each city/municipality.

Table 2-5 shows the estimated house damage in the Study Area, and summarized following table. The total estimated house damage by lahar and flood is about ₱676 million in the study area from 1991 to 1993 as given below.

Estimated House Damage by Lahar and Flood (thousand pesos)

River System	1991	1992	1993	Total
Sacobia-Bamban	257,599	219,310	11,498	488,407
Abacan	181,984	6,060	0	188,044
Total	439,583	225,370	11,498	676,451

2) Infrastructure Damage

Damage to infrastructure is estimated for the following items: roads, bridges, public buildings/structures, irrigation systems, flood control/drainage and other facilities. Unit value of each item is estimated from the product of construction cost obtained from DPWH and average depreciation ratio. Average damage rate was assumed for lahar and flood according to the previous damage report. Annual damage amount is estimated as the sum of the greater value of lahar or flood damage by each item.

Table 2-6 shows the estimated infrastructure damage in the study area, and summarized in the following table. Estimated infrastructure damage by lahar and flood is about ₱315 million in the study area from 1991 to 1993.

Estimated Infrastructure Damage by Lahar and Flood (thousand pesos)

River System	1991	1992	1993	Total
Sacobia-Bamban	58,095	37,029	30,262	125,386
Abacan	138,464	25,606	25,509	189,579
Total	196,559	62,635	55,771	314,965

3) Agriculture Damage

Agricultural damage is estimated for the following crops: rice, sugarcane, root crops, vegetable and corn. Unit value of each damageable crop is applied to the annual net income and annual gross income obtained from the DA and the other JICA studies. Damage rate for rice by flood per municipality was obtained from the DA. For other crops, the damage rate for rice and its related rate based on the damage report by the DA are applied. On the other hand, damage rate by lahar applied 1.0 based on the damage report by the DA. Based on the damage data obtained from each municipality, crop area damaged by lahar or flood are not repetitive every year; thus, annual damage amount is estimated as the sum of both lahar and flood damage. Crop damaged by lahar is estimated as net income in the first year, and accumulated gross income the following year.

Table 2-7 shows the estimated agricultural damage in the study area, and summarized in the following table. The total estimated agricultural damage by lahar and flood is about ₱700 million in the study area from 1991 to 1993.

Estimated Agriculture Damage by Lahar and Flood (thousand pesos)

River System	1991	1992	1993	Total
Sacobia-Bamban	88,857	202,210	243,292	534,358
Abacan	33,535	58,811	73,280	165,627
Total	122,392	261,021	316,572	699,985

(2) Indirect Damage

Indirect damage due to lahar and flood in the study area is estimated as the extra cost due to transportation disruption, evacuation cost and emergency clean-up cost as mentioned below. Table 2-8 shows the estimated indirect damage.

1) Extra Cost due to Transportation Disruption

Highway 3-Bamban bridge was destroyed by lahar in August 21, 1991, and it has not been reconstructed; thus, extra cost due to detour was estimated. Extra cost is estimated by the additional distance, traffic and distribution on the two bridges, vehicle operating costs, labor costs, and average speed.

The alternative route required for detour is assumed to be Highway 329 instead of Highway 3, and the additional distance is 3.8 km. The average daily traffic at Highway 329-San Francisco bridge was applied to the results of survey conducted for this study on August 1994. Average operating costs for car and truck are ₱2.29/km and ₱4.30/km, respectively, and labor cost is ₱11/hr, which are considered to be the appropriate unit costs by USAID. Average speed for vehicles is assumed at 40 km/hr. It is assumed that traffic on Highway-3 is 80 % of the total traffic if Bamban bridge is existing.

Using the above data, traffic disruption costs are estimated to be about ₱10 million in 1991 and about ₱27 million each in 1992 and 1993, or about ₱64 million in total (Table 2-2-9).

2) Evacuation Cost

Evacuation cost depends on the number of households, length of evacuation and unit evacuation cost. The households of evacuee are applied to the number of totally damaged houses. The evacuation period is assumed to be 10 weeks in the lahar event and 1 week in the flood event. Weekly cost per household is estimated at ₱216 based on the damage report.

Using the above data, evacuation cost is estimated at about ₱10 million in 1991, about ₱8 million in 1992 and about ₱0.4 million 1993, or about ₱19 million in total in Sacobia-Bamban river system; and about ₱7 million in 1991 and about ₱0.2 million in 1992, or about ₱7 million in total in Abacan river system (Table 2-2-9).

3) Emergency Clean-Up Cost

Emergency clean-up cost is the required cost to clean flood damage or lahar damage. Clean-up cost is estimated as the product of the expended period, the unit cost and the number of building. The expended period is assumed to be 6 days for lahar event and 3 days for flood event. The unit cost is assumed to be ₱150 per day which is slightly above the minimum wage. The number of buildings is applied to the number of partially damaged houses.

Using the above data, evacuation costs are estimated at about ₱1 million in 1991, about ₱0.6 million in 1992 and about ₱0.5 million in 1993, or about ₱2 million in total in Sacobia-Bamban river system; about ₱3 million in 1991, about ₱1 million in 1992 and ₱1 million in 1993, or about ₱6 million in total in Abacan river system (Table 2-2-9).

REFERENCES

Ref. No.	Title
B.1.	Terminal Report, "Mt. Pinatubo Rehabilitation and Reconstruction Program", Presidential Task Force Mt. Pinatubo, November 1992
B.2	"Immediate and Long-Term Hazards from Lahars and Excess Sedimentation in River Drainages of Mt. Pinatubo, Philippines", PHIVOLCS
B.3	"Pinatubo Lahar", PHIVOLCS, September 1993
B.4	"Pinatubo Volcano", Update, July - October 15, 1992, PHIVOLCS
B.5	"Report of Investigation on the Typhoon Kadiang- & Epang-Generated Lahar Events at the East Side Drainage of Mt. Pinatubo", PHIVOLCS, October 11, 1993
B.6	"1993 Lahars on the Eastside Drainage of Pinatubo Volcano: An Overview", PHIVOLCS
B.7.	"Mt. Pinatubo Rehabilitation & Reconstruction Program 1992-1997", Presidential Task Force Pinatubo, September 1992

TABLES

Table 1-1 Affected Persons per Municipality in the Study Area

River System / City / Municipality (No. of Barangay)		Affected Persons 1991 Ashfall	1991 Lahar	1991 Flood	1992 Lahar	1992 Flood	1993 Lahar	1993 Flood
Sacobia-Bamban River System								
Bamban	(15/15)	41,091	16,283	16,257	11,426	6,322	0	4,451
Capas	(8/19)	25,056	0	0	0	0	0	0
Concepcion	(43/43)	N/A.	10,483	0	5,202	0	23,275	3,312
Mabalacat	(28/28)	49,960	1,425	0	11,320	0	325	325
Magalang	(27/27)	2,519	0	0	2,207	1,272	701	10,553
System Total		118,626	28,191	16,257	30,155	7,594	24,301	18,641
Annual Total w/o Ashfall			28,191		30,155		38,601	
Abacan River System								
Angeles City	(33/33)	67,387	17,820	10,185	722	0	0	0
Arayat	(30/30)	73,934	0	0	0	4,213	0	17,508
Mexico	(43/43)	47,259	7,902	10,001	101	7,495	271	11,627
Santa Ana	(14/14)	32,519	2,613	6,478	2,478	6,916	4,157	8,051
System Total		221,099	28,335	26,664	3,301	18,624	4,428	37,186
Annual Total w/o Ashfall			34,299		19,346		37,186	
Grand Total			62,490		49,501		75,790	

Source : Damage Data per Barangay, MSWD

Note : The annual total without Ashfall is the sum of the greater value of Lahar or Flood in city/municipality.

Table 1-2 Affected Families per Municipality in the Study Area

River System / City / Municipality (No. of Barangay)		Affected Families 1991 Ashfall	1991 Lahar	1991 Flood	1992 Lahar	1992 Flood	1993 Lahar	1993 Flood
Sacobia-Bamban River System								
Bamban	(15/15)	7,044	2,794	2,774	1,941	1,076	0	879
Capas	(8/19)	4,817	0	0	0	0	0	0
Concepcion	(43/43)	N/A.	1,748	0	867	0	3,877	552
Mabalacat	(28/28)	6,818	285	0	2,280	0	105	65
Magalang	(27/27)	442	0	0	387	223	123	1,851
System Total		19,121	4,827	2,774	5,475	1,299	4,105	3,347
Annual Total w/o Ashfall			4,827		5,475		6,712	
Abacan River System								
Angeles City	(33/33)	17,195	4,411	2,539	155	0	0	0
Arayat	(30/30)	12,003	0	0	0	777	0	2,851
Mexico	(43/43)	7,950	1,396	1,822	24	1,285	46	1,878
Santa Ana	(14/14)	5,250	544	1,040	514	1,140	835	1,317
System Total		42,398	6,351	5,401	693	3,202	881	6,046
Annual Total w/o Ashfall			7,273		3,357		6,046	
Grand Total			12,100		8,832		12,758	

Source : Damage Data per Barangay, MSWD

Note : The annual total affected without Ashfall is the sum of the greater value of Lahar or Flood in city/municipality.

Table 1-3 Damaged Houses per Municipality in the Study Area

River System / City / Municipality	Damage	Damaged Houses						
		1991			1992		1993	
		Ashfall	Lahar	Flood	Lahar	Flood	Lahar	Flood
Sacobia-Bamban River System								
Bamban	Totally	316	2,794	153	1,941	0	0	0
	Partially	234	0	2,621	0	1,076	0	879
Capas	Totally	0	0	0	0	3	0	0
	Partially	0	0	0	0	0	0	0
Concepcion	Totally	0	1,624	0	400	0	135	0
	Partially	0	124	0	0	0	0	0
Mabalacat	Totally	0	130	0	1,528	0	65	0
	Partially	0	54	0	110	0	0	0
Magalang	Totally	0	0	0	0	0	0	3
	Partially	0	0	0	0	0	0	187
System Total	Totally	316	4,548	153	3,869	3	200	3
	Partially	234	178	2,621	110	1,076	0	1,066
Annual Total w/o Ashfall			7,347		5,058		1,269	
Abacan River System								
Angeles City	Totally	2,303	2,911	1,137	107	0	0	0
	Partially	7,016	1,498	1,402	40	0	0	0
Arayat	Totally	8	0	0	0	0	0	0
	Partially	43	0	0	0	0	0	0
Mexico	Totally	0	302	0	0	0	0	0
	Partially	142	311	17	0	0	38	15
Santa Ana	Totally	0	0	0	0	0	0	0
	Partially	5,250	544	1,040	514	1,140	835	1,317
System Total	Totally	2,311	3,213	1,137	107	0	0	0
	Partially	12,451	2,353	2,459	554	1,140	873	1,332
Annual Total w/o Ashfall			6,062		1,287		1,355	
Grand Total			13,409		6,345		2,624	

Source : Damage Data per Barangay, MSWD

Note : The annual total without Ashfall is the sum of the greater value of Lahar or Flood in city/municipality.

Table 1-4 Summary of Infrastructure Damage, Region III

ITEM	LENGTH/QUANTITY	NATURE OF DAMAGE
Roads and Bridges		
- National Roads	489 km	covered with ash 5 to 30 cm thick ashfall
- Municipal Roads	163 km	inundated by lahar/flood waters
- Major Bridges	6	collapsed by lahar
- Minor Bridges	7	partially damaged
Railway Bridges	4	washed away by lahar
Airport Facilities	2	partially damaged due to ashfall
Communication Facilities	10 Telegraph, Zambales 13 Telegraph, Pampanga 3 Telegraph, Tarlac 5 Postal in Zambales 1 Postal in Pampanga	collapse of buildings, damaged of telecom and office equipment and telephone lines
Power and Electric Facilities	302 kms of distribution lines 6040 households 294 transformers 11,794 electric meters	service interruptions destroyed
Water Supply Facilities		19 areas of Region were affected:
	Angeles Olongapo 6 municipalities, Zambales 7 municipalities, Pampanga 2 municipalities, Bataan 2 municipalities, Tarlac	
River Control Structures		8 major river systems heavily silted:
1. O'Donnell - Tarlac - Parua	41.4 km	
2. Sacobia - Bamban - Tarlac	39.7 km	
3. Abacan, Pampanga	36.3 km	
4. Pasig - Potrero, Pampanga	25.5 km	
5. Porac, Gumain, Pampanga	25.0 - 26.1 km	
6. Marella - Sto. Tomas, Zambales	10.0 - 25.4 km	
7. Maloma, Zambales	31.1 km	
8. Balin, Baquero - Bucao, Zambales	28.6 - 28.2 km	
Dike destroyed	58 km	most of these have been repaired and
River Length affected	317 km	consequently damaged/destroyed
Schools & other public buildings	659 elementary schools 24 secondary 2 tertiary 21 hospitals 38 Main health centers 74 Barangay centers 7 DOH facilities 20 Public markets 16 Municipal Buildings 10 Slaughterhouses 46 Misc. structures	mostly collapsed or heavily damaged due to ashfall
Irrigation facilities silted		
National Systems	24,839 ha	
Communal Systems	23,485 ha	

Source :
Mt. Pinatubo Rehabilitation and Reconstruction Program 2, 1992 - 1993, Main Report, Sept. 1992.
Mt. Pinatubo Rehabilitation Plan and Program, DPWH, 15 Sept. 1992.

Table 1-5 (1/3) Infrastructure Damage per Municipality in the Study Area

River System / City / Municipality / Item	Unit	Infrastructure Damage						
		1991			1992		1993	
		Ashfall	Lahar	Flood	Lahar	Flood	Lahar	Flood
Sacobia-Bamban River System								
Bamban								
National Roads	km	3.000	0	0	0	0	0	0
Local Roads	km	121.078	0	0	5.000	0	0	0
National Bridges	m	49	120	0	40	0	0	0
Local Bridges	m	152	0	0	51	0	0	0
School Buildings	room	32	0	0	6	0	0	0
Health Facilities	bldg.	12	0	0	1	0	0	0
Other Public Buildings/Structure	bldg.	38	0	0	3	0	0	0
Capas								
Local Roads	km	4.700	0	1.940	0	1.940	0	1.940
Local Bridges	m	0	0	10	0	10	0	10
Postal Communication Facilities	bldg.	1	0	1	0	0	0	0
Flood Control/Drainage	km	2.400	0	1.400	0	1.400	0	1.400
Concepcion								
National Roads	km	0	0	0	0	1	2.000	1.000
Local Roads	km	0	24.900	3.000	4.500	3.000	6.000	0
National Bridges	m	0	300	0	300	0	350	0
Local Bridges	m	0	120	0	20	0	60	40
Level I Systems	unit	0	0	0	6	0	5	0
National Irrigation Systems	km	0	5.000	0	4.000	0	0	0
Communal Irrigation Systems	km	0	39.500	0	8.000	0	11.500	0
Flood Control/Drainage	km	0	3.500	0	5.000	0	6.620	10.000
School Buildings	room	0	85	0	5	5	15	5
Health Facilities	bldg.	0	4	0	0	0	1	0
Other Public Buildings/Structure	bldg.	1	8	1	2	2	1	1
Mabalacat								
National Roads	km	0	0	0	5.400	0	0	0
National Bridges	m	0	0	25	0	0	0	0
Local Bridges	m	0	0	20	0	0	0	0
Flood Control/Drainage	km	0	0	0	0	0.030	0	0
School Buildings	room	0	0	0	19	0	0	3
Other Public Buildings/Structure	bldg.	1	0	1	0	0	1	0
Magalang								
Local Roads	km	0	0	0	0	0	0	2.506
Flood Control/Drainage	km	0	0	0	0	0	0	2.200

(contd.)

Table 1-5 (2/3) Infrastructure Damage per Municipality in the Study Area

River System / City / Municipality / Item	Unit	Infrastructure Damage						
		1991			1992		1993	
		Ashfall	Lahar	Flood	Lahar	Flood	Lahar	Flood
Sacobia-Bamban River System Sub-Total								
National Roads	km	3.000	0	0	5.400	1.000	2.000	1.000
Local Roads	km	125.778	24.900	4.910	9.500	4.910	6.000	4.416
National Bridges	m	49	420	25	340	0	350	0
Local Bridges	m	152	120	30	71	10	60	50
Postal Communication Facilities	bldg.	1	0	1	0	0	0	0
Level I Systems	unit	0	0	0	6	0	5	0
National Irrigation Systems	km	0	5.000	0	4.000	0	0	0
Communal Irrigation Systems	km	0	39.500	0	8.000	0	11.500	0
Flood Control/Drainage	km	2.400	3.500	1.400	5.000	1.430	6.620	13.600
School Buildings	room	32	85	0	30	5	15	8
Health Facilities	bldg.	12	4	0	1	0	1	0
Other Public Buildings/Structure	bldg.	40	8	2	5	2	2	1
Abacan River System								
Angeles City								
National Roads	km	11.280	4.000	4.000	0	5.000	0	4.000
Local Roads	km	145.613	98.000	30.000	10.000	70.000	11.000	50.000
National Bridges	m	491	180	0	0	0	0	0
Local Bridges	m	620	398	0	0	0	0	0
Water District Facilities	unit	9	0	0	0	0	0	0
School Buildings	room	55	66	20	0	0	0	0
Health Facilities	bldg.	4	5	5	0	0	0	0
Other Public Buildings/Structure	bldg.	16	13	8	0	0	0	0
Arayat								
School Buildings	room	347	0	106	0	118	0	153
Mexico								
National Roads	km	14.160	3.200	1.000	0	0.000	0	0
Local Roads	km	35.000	11.200	10.600	2.400	3.600	0	7.500
National Bridges	m	900	0	150	0	0	0	0
Local Bridges	m	220	100	100	0	80	0	80
NPC Facilities	bldg.	1	0	0	0	0	0	0
Electric Cooperatives	bldg.	1	0	0	0	0	0	0
Water District Facilities	unit	2	0	0	0	0	0	0
Level I Systems	unit	34	12	18	0	3	0	7
National Irrigation Systems	km	5.400	3.000	5.100	0	2.100	0	2.100
Communal Irrigation Systems	km	25.500	10.000	7.900	0	7.900	0	11.900
Flood Control/Drainage	km	33.100	14.000	26.700	6.400	18.900	6.400	18.900
School Buildings	room	148	30	26	0	0	0	0
Health Facilities	bldg.	7	1	1	0	0	0	0
Other Public Buildings/Structure	bldg.	21	2	0	0	0	0	0

(contd.)

Table 1-5 (3/3) Infrastructure Damage per Municipality in the Study Area

River System / City / Municipality / Item	Unit	Infrastructure Damage						
		1991			1992		1993	
		Ashfall	Lahar	Flood	Lahar	Flood	Lahar	Flood
Santa Ana								
Local Roads	km	0	0	0.200	0	0.200	0	0.300
Local Bridges	m	0	50	0	0	0	0	0
Flood Control/Drainage	km	0	23.000	23.000	23.000	23.000	23.000	23.000
Abacan River System Sub-Total								
National Roads	km	25.440	7.200	5.000	0	5.000	0	4.000
Local Roads	km	180.613	109.200	40.800	12.400	73.800	11.000	57.800
National Bridges	m	1,391	180	150	0	0	0	0
Local Bridges	m	840	548	100	0	80	0	80
NFC Facilities	bldg.	1	0	0	0	0	0	0
Electric Cooperatives	bldg.	1	0	0	0	0	0	0
Water District Facilities	unit	11	0	0	0	0	0	0
Level I Systems	unit	34	12	18	0	3	0	7
National Irrigation Systems	km	5.400	3.000	5.100	0	2.100	0	2.100
Communal Irrigation Systems	km	25.500	10.000	7.900	0	7.900	0	11.900
Flood Control Drainage	km	33.100	37.000	49.700	29.400	41.900	29.400	41.900
School Buildings	room	55	66	20	0	0	0	0
Health Facilities	bldg.	495	30	132	0	118	0	153
LTO Buildings	bldg.	11	6	6	0	0	0	0
Other Public Buildings	bldg.	37	15	8	0	0	0	0
Grand Total								
National Roads	km	28.440	7.200	5.000	5	6.000	2	5.000
Local Roads	km	306.391	134.100	45.740	21.900	78.740	17.000	62.246
National Bridges	m	1,410	600	175	340	0	350	0
Local Bridges	m	992	668	130	71	90	60	130
Postal Communication Facilities	bldg.	1	0	1	0	0	0	0
NFC Facilities	bldg.	1	0	0	0	0	0	0
Electric Cooperatives	bldg.	1	0	0	0	0	0	0
Water District Facilities	unit	11	0	0	0	0	0	0
Level I Systems	unit	34	12	18	6	3	5	7
National Irrigation Systems	km	5	8	5	4	2	0	2
Communal Irrigation Systems	km	26	50	8	8	8	12	12
Flood Control/Drainage	km	35.500	40.500	51.100	34.400	43.330	36.020	55.500
School Buildings	room	87	151	20	30	5	15	8
Health Facilities	bldg.	507	34	132	1	118	1	153
LTO Buildings	bldg.	11	6	6	0	0	0	0
Other Public Buildings/Structure	bldg.	40	8	2	5	2	2	1

Source : Damage Data per Barangay prepared by the Municipal Engineer; and
damage Report prepared by Angeles City Planning Office

Table 1-6 (1/2) Crop Area Damaged per Municipality in the Study Area

(Unit : ha)

River System / City / Municipality	Crop	Damaged Crop Area 1991 Ashfall	1991 Lahar	1991 Flood	1992 Lahar	1992 Flood	1993 Lahar	1993 Flood
Sacobia-Bamban River System								
Bamban	Rice	2,326.50	1,145.00	215.00	0	165.00	0	165.00
	Sugarcane	1,441.00	435.00	70.00	0	10.00	0	10.00
	Root Crops	120.00	5.00	0	0	0	0	0
	Vegetable	59.00	33.00	15.00	0	0	0	0
	Corn	30.00	5.00	5.00	0	0	0	0
	Crops Sub-Total	3,976.50	1,623.00	305.00	0	175.00	0	175.00
Capas	Rice	1,169.00	38.00	0	0	0	0	0
	Sugarcane	332.00	0	0	0	0	0	0
	Root Crops	6.00	0	0	0	0	0	0
	Vegetable	0	0	0	0	0	0	0
	Corn	0	0	0	0	0	0	0
	Crops Sub-Total	1,507.00	38.00	0	0	0	0	0
Concepcion	Rice	N/A.	4,886.35	0	1,224.75	1,949.25	75.00	0
	Sugarcane	N/A.	100.00	0	50.00	0	30.00	0
	Root Crops	N/A.	30.00	0	0	0	0	0
	Vegetable	N/A.	18.00	0	10.00	0	7.00	0
	Corn	N/A.	15.00	0	150.00	0	0	0
	Crops Sub-Total	0	5,049.35	0	1,434.75	1,949.25	112.00	0
Mabalacat	Rice	N/A.	100.00	0	293.00	0	108.00	0
	Sugarcane	N/A.	146.00	0	567.00	0	155.50	0
	Root Crops	N/A.	0	0	0	0	0	0
	Vegetable	N/A.	0	0	0	0	0	0
	Corn	N/A.	0	0	0	0	0	0
	Crops Sub-Total	N/A.	246.00	0	860.00	0	263.50	0
Magalang	Rice	369.10	0	0	425.04	582.85	232.78	3,107.17
	Sugarcane	0	0	0	169.40	0	173.07	0
	Root Crops	0	0	0	3.50	0	0	0
	Vegetable	0	0	0	0.25	0	8.50	11.50
	Corn	0	0	0	0	0	0	0
	Crops Sub-Total	369.10	0	0	598.19	582.85	414.35	3,118.67
System Total	Rice	3,864.60	6,169.35	215.00	1,942.79	2,697.10	415.78	3,272.17
	Sugarcane	1,773.00	681.00	70.00	786.40	10.00	358.57	10.00
	Root Crops	126.00	35.00	0	3.50	0	0	0
	Vegetable	59.00	51.00	15.00	10.25	0	15.50	11.50
	Corn	30.00	20.00	5.00	150.00	0	0	0
	Crops Sub-Total	5,852.60	6,956.35	305.00	2,892.94	2,707.10	789.85	3,293.67
Accumulated Crops Area Damaged by Lahar			6,956		9,849		10,639	

Source : Damage Data per Barangay, MA
Crops exclude rice in Concepcion applied to Municipal damage data prepared by DA Tarlac.

Note : Crop area covered by Lahar in the previous year are not included in the next year.

Table 1-6 (2/2) Crop Area Damaged per Municipality in the Study Area

(Unit : ha)

River System / City / Municipality	Crop	Damaged Crop Area						
		1991			1992		1993	
		Ashfall	Lahar	Flood	Lahar	Flood	Lahar	Flood
Abacan River System								
Angeles City	Rice	267.50	82.00	0	0	0	0	0
	Sugarcane	772.90	10.00	0	0	0	0	0
	Root Crops	749.35	2.00	0	0	0	0	0
	Vegetable	23.50	1.00	0	0	0	0	0
	Corn	10.10	0	0	0	0	0	0
	Crops Sub-Total	1,823.35	95.00	0	0	0	0	0
Arayat	Rice	165.00	118.00	655.00	80.00	590.00	55.00	1,165.00
	Sugarcane	120.00	0	0	0	10.00	0	0
	Root Crops	18.00	0	20.00	0	5.00	0	10.00
	Vegetable	70.00	20.00	195.00	5.00	265.00	10.00	495.00
	Corn	5.00	0	100.00	0	168.00	0	246.00
	Crops Sub-Total	378.00	138.00	970.00	85.00	1,038.00	65.00	1,916.00
Mexico	Rice	3,377.00	1,266.00	354.00	0	521.00	220.00	705.00
	Sugarcane	1,029.00	180.00	0	0	12.00	0	18.00
	Root Crops	35.00	7.00	3.00	0	1.00	0	22.00
	Vegetable	189.00	54.00	12.00	0	24.00	0	42.00
	Corn	299.00	89.00	22.00	0	12.00	0	22.00
	Crops Sub-Total	4,929.00	1,596.00	391.00	0	570.00	220.00	809.00
Santa Ana	Rice	N/A.	394.00	266.00	0	597.50	0	1,542.00
	Sugarcane	N/A.	0	0	0	0	0	0
	Root Crops	N/A.	0	0	0	0	0	0
	Vegetable	N/A.	0	0	0	0	0	73.87
	Corn	N/A.	0	0	0	0	0	0
	Crops Sub-Total	0	394.00	266.00	0	597.50	0	1,615.87
System Total	Rice	3,809.50	1,860.00	1,275.00	80.00	1,708.50	275.00	3,412.00
	Sugarcane	1,921.90	190.00	0	0	22.00	0	18.00
	Root Crops	802.35	9.00	23.00	0	6.00	0	32.00
	Vegetable	282.50	75.00	207.00	5.00	289.00	10.00	610.87
	Corn	314.10	89.00	122.00	0	180.00	0	268.00
	Crops Sub-Total	7,130.35	2,223.00	1,627.00	85.00	2,205.50	285.00	4,340.87
Accumulated Crops Area Damaged by Lahar			2,223		2,308		2,593	
Grand Total			9,179		12,157		13,232	

Source : Dar Damage Data per Barangay, MA

Note : Crop area covered by Lahar in the previous year are not included in the next year.

Table 2-1 Estimated Cost of Damages on Public Infrastructure in Region III, 1991

(As of 23 August 1991) (in thousand pesos)

Infrastructure Sub-Sector/ Facility	Western Areas				Eastern Areas				Other Areas			Grand Total	Percent Dist.
	Zambales	Bataan	Olongapo	Total	Pampanga	Tarlac	Angeles	Total	Bulacan	N. Ecija	Total		
TRANSPORTATION	185,320	69,660	67,546	322,526	208,676	36,502	509,650	754,828	32,309	40,245	72,554	1,149,908	30.0%
Roads and Bridges	170,320	69,660	67,546	307,526	183,676	25,502	475,650	684,828	32,309	40,245	72,554	1,064,908	27.8%
1. National System	98,893	63,164	9,300	171,357	111,526	10,375	475,650	597,551	13,460	15,220	28,680	797,588	20.8%
- Roads	33,093	63,000	9,300	105,393	31,666	6,725	14,000	52,391	9,160	13,120	22,280	180,064	4.7%
- Bridges	65,800	164	0	65,964	79,860	3,650	461,650	545,160	4,300	2,100	6,400	617,524	16.1%
2. Local Roads and Bridges	71,427	6,496	58,246	136,169	72,150	15,127	0	87,277	18,849	25,025	43,874	267,320	7.0%
- Provincial City	8,653	1,769	58,246	68,668	50	1,895	0	1,945	3,701	5,600	9,301	79,914	2.1%
- Municipal	27,500	270	0	27,770	16,100	255	0	16,355	0	555	555	44,680	1.2%
- Barangay	35,274	4,457	0	39,731	56,000	12,977	0	68,977	15,148	18,870	34,018	142,726	3.7%
Railway Facilities	0	0	0	0	25,000	11,000	34,000	70,000	0	0	0	70,000	1.8%
Airport Facilities	15,000	0	0	15,000	0	0	0	0	0	0	0	15,000	0.4%
COMMUNICATION	6,992	0	4,012	11,004	1,707	344	160	2,211	0	0	0	13,215	0.3%
Telecommunications Facilities	6,702	0	2,712	9,414	1,707	344	160	2,211	0	0	0	11,625	0.3%
Postal Communication Facilities	290	0	1,300	1,590	0	0	0	0	0	0	0	1,590	0.0%
POWER AND ELECTRIFICATION	22,571	2,938	3,244	28,753	14,771	11,095	298	26,164	0	0	0	54,918	1.4%
NPC Facilities	860	1,199	3,244	5,303	0	2,025	298	2,323	0	0	0	7,627	0.2%
Electric Cooperatives	21,711	1,739	0	23,450	14,771	9,070	0	23,841	0	0	0	47,291	1.2%
WATER RESOURCES	732,973	41,400	119,250	893,623	342,738	229,960	81,222	653,920	11,050	10,050	21,100	1,568,642	40.9%
Water Supply Facilities	17,306	2,000	65,000	84,306	25,205	3,447	10,000	38,652	0	0	0	122,957	3.2%
1. Water District Facilities	15,641	2,000	65,000	82,641	20,840	3,447	10,000	34,287	0	0	0	116,927	3.1%
2. Level I Systems	1,665	0	0	1,665	4,365	0	0	4,365	0	0	0	6,030	0.2%
Irrigation Facilities	57,895	12,982	0	70,877	79,990	31,547	1,897	113,434	0	0	0	184,311	4.8%
1. National Irrigation Systems	25,017	2,275	0	27,292	17,828	21,089	0	38,917	0	0	0	66,209	1.7%
2. Communal Irrigation Systems	32,878	10,707	0	43,585	62,162	10,458	1,897	74,517	0	0	0	118,102	3.1%
Flood Control/Drainage	657,772	26,418	54,250	738,440	237,543	194,966	69,325	501,834	11,050	10,050	21,100	1,261,374	32.9%
SOCIAL INFRASTRUCTURE	499,476	39,105	236,080	774,661	168,187	51,842	41,212	261,241	5,150	4,655	9,805	1,045,708	27.3%
School Buildings	409,690	33,475	141,930	585,095	129,811	13,050	11,940	154,801	5,050	3,155	8,205	748,102	19.5%
Health Facilities	16,200	3,120	14,650	33,970	7,730	4,810	24,150	36,690	0	0	0	70,660	1.8%
LTO Buildings	186	700	200	1,086	96	92	122	310	0	0	0	1,396	0.0%
Other Public Buildings/Structure	73,400	1,810	79,300	154,510	30,550	33,890	5,000	69,440	100	1,500	1,600	225,550	5.9%
Grand Total	1,447,332	153,103	430,132	2,030,567	736,079	329,742	632,542	1,698,364	48,510	54,950	103,460	3,832,390	100.0%
Percent Distribution	37.8%	4.0%	11.2%	53.0%	19.2%	8.6%	16.5%	44.3%	1.3%	1.4%	2.7%	100.0%	

Source : The Regional Task Force Secretariat/NEDA Regional Office III.

Table 2-2 Actual Damage by Commodity in Region III, 1991 and 1992

Commodity	Province	1991 (*1) Area Damaged (ha)	1991 (*1) Value (pesos)	1992 (*2) Value (pesos)
Rice	Bataan	10,057	16,516,064	
	Bulacan	636	1,761,270	
	Nueva Ecija	0	0	
	Pampanga	29,485	255,644,355	
	Tarlac	25,400	67,783,655	
	Zambales	16,317	9,150,250	
	Sub-total	81,895	350,855,594	510,350,548
Vegetables	Bataan	169	6,629,296	
	Bulacan	111	1,657,500	
	Nueva Ecija	0	0	
	Pampanga	1,001	107,830,760	
	Tarlac	904	42,660,700	
	Zambales	301	4,770,200	
	Sub-total	2,486	163,548,456	36,451,090
Root Crops	Bataan	0	0	
	Bulacan	0	0	
	Nueva Ecija	0	0	
	Pampanga	1,323	159,708,365	
	Tarlac	207	8,113,000	
	Zambales	540	14,970,000	
	Sub-total	2,070	182,791,365	
Assorted Fruit Trees	Bataan	165	90,935,000	
	Bulacan	0	0	
	Nueva Ecija	0	0	
	Pampanga	410	167,490,400	
	Tarlac	40	4,500,000	
	Zambales	1,702	27,135,675	
	Sub-total	2,317	290,061,075	
Fisheries	Bataan	82	5,393,318	
	Bulacan	0	0	
	Nueva Ecija	0	0	
	Pampanga	3,817	266,648,333	
	Tarlac	2,650	7,284,187	
	Zambales	581	4,772,390	
	Sub-total	7,130	284,098,228	164,858,729
Sugarcane	Sub-total		-	56,889,027
Total		95,898	1,271,354,718	768,549,394
Livestock and Poultry (Total No. of Heads)	Bataan	32,060	5,511,080	
	Bulacan	974	349,250	
	Nueva Ecija	0	0	
	Pampanga	716,677	176,822,180	
	Tarlac	15,136	4,985,640	
	Zambales	13,867	15,523,050	
Total		778,714	203,191,200	9,755,485
Grand Total			1,474,545,918	778,304,879

Source: *1 Presidential Task Force on Mt. Pinatubo, 1992
*2 Regional Disaster Coordinating Council, Region III

Table 2-3 Unit Value of Damageable Property

Item		Unit Value
I. Direct Damage		
1. Building		
1) Residential		
	Dwelling	48,710 pesos/building
	Household Effects	7,930 pesos/building
2) Non-Residential		
	Building	269,330 pesos/building
	Inventory Stocks/Equipment	83,000 pesos/building
3) Commercial		
	Building	1,233,800 pesos/building
	Contents	1,205,400 pesos/building
2. Agricultural Crops		
1) Crop		
	Rice	11,690 pesos/ha
	Sugarcane	20,930 pesos/ha
	Root Crops	7,000 pesos/ha
	Vegetable	6,000 pesos/ha
	Corn	9,810 pesos/ha
3. Infrastructure		
1) Road		
	National Road	1,750 pesos/m
	Provincial/Municipal Road	1,400 pesos/m
	Barangay Road	300 pesos/m
2) Bridge		
	National Bridge	60,000 pesos/m
	Provincial/Municipal Bridge	50,000 pesos/m
	Barangay Bridge	30,000 pesos/m
3) Flood Control (Earth Dike)		900 pesos/m
4) Irrigation Canal		640 pesos/m
5) Others(Water/Power Supply, Tele. Facility)		400 pesos/person
II. Indirect Damage		
1. Extra Cost due to Transportation Disruption		Operating and Labor Cost
2. Evacuation Cost		216 pesos/family/week
3. Emergency Clean-Up Costs		150 pesos/day/building

Basic Source of Data :

- Study of Agno River Basin Flood Control, Final Report Volume V, Supporting Report Part II Feasibility Study, December, 1991
- Mount Pinatubo Recovery Action Plan Long Term Report, Technical Appendix C Economic Analysis, March 1994
- Capital Outlays, Average Unit Cost, DPWH, December 1990
- Interview at the Site

Note : Assuming a Depreciation Ratio of 50%

Table 2-4 Summary of Estimated Damage in the Study Area

(Unit : thousand pesos)

River System / Item	Damage Amount by Lahar and Flood 1991	1992	1993	Total
Sacobia-Bamban River System				
Direct Damage				
- House	257,599	219,310	11,498	488,407
- Infrastructure	58,095	37,029	30,262	125,386
- Agriculture	88,857	202,210	243,292	534,358
Indirect Damage				
- Extra Cost due to Transportation Disruption	9,819	27,020	26,946	63,784
- Evacuation Cost	9,857	8,358	433	18,647
- Emergency Clean-Up Cost	1,340	583	480	2,403
Total	425,565	494,509	312,910	1,232,984
Abacan River System				
Direct Damage				
- House	181,984	6,060	0	188,045
- Infrastructure	138,464	25,606	25,509	189,579
- Agriculture	33,535	58,811	73,280	165,627
Indirect Damage				
- Evacuation Cost	7,186	231	0	7,417
- Emergency Clean-Up Cost	3,224	1,012	1,385	5,621
Total	364,394	91,721	100,174	556,289
Grand Total	789,959	586,230	413,084	1,789,273

Table 2-5 Estimated House Damage in the Study Area

(Unit : thousand pesos)

River System / City / Municipality	Damage Amount of Totally Destroyed Houses					
	1991		1992		1993	
	Lahar	Flood	Lahar	Flood	Lahar	Flood
Sacobia-Bamban River System						
Bamban	158,252	8,666	109,938	0	0	0
Capas	0	0	0	170	0	0
Concepcion	91,983	0	22,656	0	7,646	0
Mabalacat	7,363	0	86,546	0	3,682	0
Magalang	0	0	0	0	0	170
Total	257,599	8,666	219,140	170	11,328	170
Annual Total	257,599		219,310		11,498	
Accumulated Total	257,599		476,909		488,407	
Abacan River System						
Angeles City	164,879	64,400	6,060	0	0	0
Arayat	0	0	0	0	0	0
Mexico	17,105	0	0	0	0	0
Santa Ana	0	0	0	0	0	0
Total	181,984	64,400	6,060	0	0	0
Annual Total	181,984		6,060		0	
Accumulated Total	181,984		188,045		188,045	
Grand Total	439,583		664,954		676,452	

Source : Damage Data per Barangay, MSWD

Note : The annual damage amount is the sum of the greater value of Lahar or Flood in each city/municipality

Assumption : Unit value of totally destroyed house is estimated at 65,000 pesos per house.

Table 2-6 Estimated Infrastructure Damage in the Study Area

(Unit : thousand pesos)

River System / Facility / Item	Unit Value		Infrastructure Damage Amount					
			1991		1992		1993	
			Lahar	Flood	Lahar	Flood	Lahar	Flood
Sacobia-Bamban River System								
Roads and Bridges								
National Roads	1,750	P/m	0	0	4,725	88	1,750	88
Local Roads	1,400	P/m	17,430	346	6,650	346	4,200	311
National Bridges	60,000	P/m	12,600	75	10,185	0	10,500	0
Local Bridges	50,000	P/m	3,000	75	1,763	25	1,500	125
Public Building/Structure	352,330	P/bldg.	3,611	53	1,585	44	793	32
Irrigation Systems (Canal)	640	P/m	14,240	0	3,840	0	3,680	0
Flood Control/Drainage	900	P/m	1,575	63	2,250	64	2,979	612
Other Facilities (Water, Power, Tel.)	400	P/person	5,638	325	6,031	152	4,860	373
Annual Total			58,095		37,029		30,262	
Accumulated Total			58,095		95,124		125,386	
Abacan River System								
Roads and Bridges								
National Roads	1,750	P/m	6,300	438	0	438	0	350
Local Roads	1,400	P/m	76,440	2,856	8,680	5,166	7,700	4,046
National Bridges	60,000	P/m	5,400	450	0	0	0	0
Local Bridges	50,000	P/m	13,700	250	0	200	0	200
Public Building/Structure	352,330	P/bldg.	10,147	2,607	0	2,079	0	2,695
Irrigation Systems (Canal)	640	P/m	4,160	416	0	320	0	448
Flood Control/Drainage	900	P/m	16,650	2,237	13,230	1,886	13,230	1,886
Other Facilities (Water, Power, Tel.)	400	P/person	5,667	533	660	372	886	744
Annual Total			138,464		25,606		25,509	
Accumulated Total			138,464		164,071		189,579	
Annual Grand Total			196,559		62,635		55,771	
Accumulated Grand Total			196,559		259,194		314,965	

Basic Source of Data :

- Damage Data per Barangay prepared by Municipal Engineer
- Damage Report prepared by Angeles City Planning Office
- Study of Agno River Basin Flood Control, Final Report Volume V, Supporting Report Part II Feasibility Study, December 1991
- Mount Pinatubo Recovery Action Plan Long Term Report, Technical Appendix C Economic Analysis, March 1994
- Capital Outlays, Average Unit Cost, DPWH, December 1990
- Interview at the Site

Assumption :

- Damage Rate for Lahar 50%
- Damage Rate for Flood 5%

Note :

- The annual total is the sum of the greater of the Lahar or Flood by each item

Table 2-7 (1/2) Estimated Agricultural Damage in the Study Area

(Unit : thousand pesos)

River System / City / Municipality	Crop	Flood Damage Rate(%)	Agricultural Damage Amount 1991 Lahar	1991 Flood	1992 Lahar	1992 Flood	1993 Lahar	1993 Flood
Sacobia-Bamban River System								
Bamban	Rice	43%	13,385	1,081	23,724	829	23,724	829
	Sugarcane	39%	9,105	571	15,660	82	15,660	82
	Root Crops	56%	35	0	125	0	125	0
	Vegetable	68%	198	61	667	0	667	0
	Corn	47%	49	23	83	0	83	0
	Crops Sub-Total		22,772	1,736	40,259	911	40,259	911
Capas	Rice	6%	444	0	787	0	787	0
	Sugarcane	5%	0	0	0	0	0	0
	Root Crops	8%	0	0	0	0	0	0
	Vegetable	10%	0	0	0	0	0	0
	Corn	7%	0	0	0	0	0	0
	Crops Sub-Total		444	0	787	0	787	0
Concepcion	Rice	23%	57,121	0	115,562	5,241	127,499	0
	Sugarcane	21%	2,093	0	4,647	0	6,028	0
	Root Crops	30%	210	0	750	0	750	0
	Vegetable	37%	108	0	424	0	608	0
	Corn	25%	147	0	1,719	0	2,723	0
	Crops Sub-Total		59,680	0	123,102	5,241	137,607	0
Mabalacat	Rice	49%	1,169	0	5,497	0	9,405	0
	Sugarcane	45%	3,056	0	17,123	0	28,923	0
	Root Crops	63%	0	0	0	0	0	0
	Vegetable	78%	0	0	0	0	0	0
	Corn	53%	0	0	0	0	0	0
	Crops Sub-Total		4,225	0	22,620	0	38,328	0
Magalang	Rice	11%	0	0	4,969	749	11,528	3,996
	Sugarcane	10%	0	0	3,546	0	9,721	0
	Root Crops	14%	0	0	25	0	88	0
	Vegetable	18%	0	0	2	0	56	12
	Corn	12%	0	0	0	0	0	0
	Crops Sub-Total		0	0	8,540	749	21,392	4,008
System Total	Rice		72,120	1,081	150,540	6,820	172,944	4,825
	Sugarcane		14,253	571	40,975	82	60,331	82
	Root Crops		245	0	900	0	963	0
	Vegetable		306	61	1,092	0	1,330	12
	Corn		196	23	1,802	0	2,805	0
	Crops Sub-Total		87,120	1,736	195,308	6,901	238,373	4,919
Annual Total			88,857		202,210		243,292	
Accumulated Total			88,857		291,066		534,358	

(contd.)

Table 2-7 (2/2) Estimated Agricultural Damage in the Study Area

(Unit : thousand pesos)

River System / City / Municipality	Crop	Flood Damage Rate(%)	Agricultural Damage Amount 1991 Lahar	1991 Flood	1992 Lahar	1992 Flood	1993 Lahar	1993 Flood
Abacan River System								
Angeles City	Rice	60%	959	0	1,699	0	1,699	0
	Sugarcane	55%	209	0	360	0	360	0
	Root Crops	78%	14	0	50	0	50	0
	Vegetable	95%	6	0	20	0	20	0
	Corn	65%	0	0	0	0	0	0
	Crops Sub-Total		1,188	0	2,129	0	2,129	0
Arayat	Rice	35%	1,379	2,680	3,380	2,414	4,746	4,767
	Sugarcane	32%	0	0	0	67	0	0
	Root Crops	45%	0	63	0	16	0	32
	Vegetable	56%	120	655	434	890	565	1,663
	Corn	38%	0	373	0	626	0	917
	Crops Sub-Total		1,499	3,771	3,814	4,013	5,311	7,378
Mexico	Rice	21%	14,800	869	26,232	1,279	28,803	1,731
	Sugarcane	19%	3,767	0	6,480	48	6,480	72
	Root Crops	27%	49	6	175	2	175	42
	Vegetable	33%	324	24	1,091	48	1,091	83
	Corn	23%	873	50	1,469	27	1,469	50
	Crops Sub-Total		19,813	948	35,446	1,403	38,018	1,977
Santa Ana	Rice	55%	4,606	1,710	8,164	3,842	8,164	9,914
	Sugarcane	50%	0	0	0	0	0	0
	Root Crops	71%	0	0	0	0	0	0
	Vegetable	88%	0	0	0	0	0	390
	Corn	60%	0	0	0	0	0	0
	Crops Sub-Total		4,606	1,710	8,164	3,842	8,164	10,304
System Total	Rice		21,743	5,259	39,474	7,535	43,412	16,412
	Sugarcane		3,977	0	6,840	115	6,840	72
	Root Crops		63	69	225	18	225	73
	Vegetable		450	679	1,545	938	1,676	2,136
	Corn		873	422	1,469	653	1,469	967
	Crops Sub-Total		27,106	6,429	49,553	9,258	53,621	19,659
Annual Total			33,535		58,811		73,280	
Accumulated Total			33,535		92,347		165,627	
Annual Grand Total			122,392		261,021		316,572	
Accumulated Grand Total			122,392		383,413		699,985	

Source : Damage Area per Barangay, MA

Damage Rate of rice per Municipality, PA

Note : Crop area covered by Lahar in the previous year are not included in the next year.

Assumption :

- Damage by Lahar in the first year are estimated at net income, and accumulated the gross income in the next year
- Damage by Flood are estimated at the multiply the net income by damage rate.
- Damage rate for rice by flood are estimated at the actual area of completely damaged divided by area affected.
- Damage rates for the other crops by flood are applied to the multiply the rate of rice by following rates.

Crop	Annual Net Income (P/ha)	Annual Gross Income (P/ha)	Lahar Damage Rate	Flood Damage Rate (Rice=1.0)
Rice	11,690	20,720	1.00	1.00
Sugarcane	20,930	36,000	1.00	0.91
Root Crops	7,000	25,000	1.00	1.30
Vegetable	6,000	20,200	1.00	1.59
Corn	9,810	16,500	1.00	1.09

Table 2-8 Estimated Indirect Damage in the Study Area

Item		Damage Amount
(1) Extra Cost due to Transportation Disruption		
Due to the Bamban bridge failure	1991	9,818,596 pesos
	1992	27,019,595 pesos
	1993	26,945,771 pesos
	Total	63,783,961 pesos

Assumptions
- Additional Distance of Route 329 in place of Route 3
  Estimated Increase in Distance: 3.8 km
- Average Traffic at San Francisco Bridge (vehicle/day)

Truck	Bus	Jeepny	Sedan	Total
1,080	1,196	1,805	3,603	7,684

- Distribution of Route 3 and Route 329: 8 : 2
- Operating Cost
  Truck/Bus: 4.30 pesos/km/vehicle
  Jeepny/Sedan: 2.29 pesos/km/vehicle
- Labor Cost: 11 pesos/hr
- Average Speed: 40 km/hr

(2) Evacuation Cost

Sacobia-Bamban River System (pesos)

Year	Lahar	Flood	Total
1991	9,823,680	33,048	9,856,728
1992	8,357,040	648	8,357,688
1993	432,000	648	432,648
Total	18,612,720	34,344	18,647,064

Abacan River System (pesos)

Year	Lahar	Flood	Total
1991	6,940,080	245,592	7,185,672
1992	231,120	0	231,120
1993	0	0	0
Total	7,171,200	245,592	7,416,792

Assumptions
- Evacuation Cost: 216 pesos/family/week
- Evacuated period by Lahar: 10 weeks
- Evacuated period by Flood: 1 weeks
- The family of evacuee are assumed of the number of totally damaged houses.

(3) Emergency Clean-Up Cost

Sacobia-Bamban River System (pesos)

Year	Lahar	Flood	Total
1991	160,200	1,179,450	1,339,650
1992	99,000	484,200	583,200
1993	0	479,700	479,700
Total	259,200	2,143,350	2,402,550

Abacan River System (pesos)

Year	Lahar	Flood	Total
1991	2,117,700	1,106,550	3,224,250
1992	498,600	513,000	1,011,600
1993	785,700	599,400	1,385,100
Total	3,402,000	2,218,950	5,620,950

Assumptions
- Emergency clean-up cost: 150 pesos/day/building
- Expended period by Lahar: 6 days
- Expended period by Flood: 3 days
- The number of building affected are assumed of the number of partially damaged houses

Basic Source of Data :
- Damage Data per Barangay, MSWD
- Mount Pinatubo Recovery Action Plan Long Term Report, Technical Appendix C Economic Analysis, March 1991
- Interview at the Site