APPENDIX F

ENVIRONMENTAL IMPACT ASSESSMENT

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CHAPTER I PAST AND EXISTING ENVIRONMENTAL CONDITIONS

1.1 General

This chapter presents a description of the present and historical trends of the environment at the project site. Its objective is to provide the necessary baseline information regarding the natural environment and the socio-economic setting of the project area. The project area is shown in Figs. F.1.1.

1.2 Climate

Climate of the Laoag River Basin has two distinct seasons. May to October is the wet season, while the dry season is between November to April. The estimated average annual rainfall is 2,135 mm at Laoag City for the period of 1961 to 1995. Ninety seven percent (97%) of the rainfall events occurred during the wet season. Average monthly rainfall varies from 1 mm in February to 580 mm in August. Recorded temperature in Laoag City showed an annual average of 27.0 °C with a lowest value of 24.5 °C (January) and a highest value of 29.1 °C (May).

Every year, tropical cyclones affect the area with heavy rainfall. During the past 48 years, 250 cyclones hit or came close to the area. Big cyclones affect the area on an average of three times a year with a rainfall of more than 50 mm. About 75% of such big cyclones occurred between July to September.

Typhoon Gloring was the most recent typhoon which provided a good opportunity for rainfall observation. It brought a heavy storm rainfall in the area between 23 to 27 of July 1996. This typhoon caused a large flood in the entire stretches of the Laoag River. Its 3-day rainfall varied from 594 mm to 795 mm with a maximum hourly range of 30 mm to 69 mm.

1.3 Geology and Terrain

1.3.1 Geology

The Laoag River Basin has eleven stratigraphic sequence: (1) Recent Sand Dunes, (2) Recent Alluvium, (3) Recent Alluvial Fan Deposits, (4) Plio-Pleistocene Sediments, (5) Middle to Upper Miocene Limestone, (6) Middle to Upper Miocene Sediments, (7) Plio-Pleistocene Volcanic, (8) Neogene Intrusive, (9) Lower Miocene Volcanic, (10) Cretaceous-Paleogene Metarock, and (11) Cretaceous-Paleogene Intrusive.

Geologically, the eastern part of the basin is mainly Neogene Intrusive and Cretaceous-Paleogene Metarock. The rocks in the middle to lower portions of the Cura, Labugaon, Solsona, and Madongan watersheds are of the weathered Neogene Intrusive materials which have disintegrated into some thick loose granular material. Extending over the eastern watersheds are materials of Cretaceous-Paleogene Metarock materials which are highly faulted and jointed with fracture zone in some places.

1.3.2 Floodplain Topography

The Laoag River Basin has various topographic features that could be classified into eight micro-topographic components which are described below.

(1) Alluvial Fan

Sediment deposits of the Cura, Labugaon, Solsona, Madongan, Papa, and Bongo Rivers formed the major alluvial fans which are rugged due to the existence of old channels, gully erosion, and natural levees. Sediments are still deposited in the old channels by the overflowing flood waters.

The alluvial fans of the Solsona, Madongan, and Papa Rivers are widespread. Those of the Cura, Labugaon, and Bongo Rivers are confined within a long and narrow area of the surrounding terraces and hills.

(2) Valley Plain

This is formed in areas where hills and plateaus restrict the development of a fan-shaped topography such as along the Guisit River. During a large flood, water flows down the entire section of the valley plain.

(3) Flood Plain

These are plain areas which are a few meters higher than the existing riverbeds and formed a terrace-like topography. Small scale flood will not submerge these plains. Flood plains are found on the left bank of the Laoag-Bongo River between the confluence with the Papa and Guisit Rivers. These are also found in both banks of the lower reaches of the Laoag River.

(4) River Terrace

These are nearly level surfaces of a river bank bordering a steeper slope. The major river terraces are located along the right bank of the Cura River and the left bank of the Upper Bongo River. The poblacions of Banna and Nueva Era are located on the terrace along the Upper Bongo River which is single step type and located 20 to 30 meters above the existing riverbed.

(5) Sand Dune

At both sides of the river mouth and along the coastal line extending over 1.5 kilometers is an unstable sand dune. A stable sand dune has developed at the hinterland of the unstable sand dune.

(6) Natural Levee

These are broad and low embankments that built up along the banks of a river channel during floods. Natural levees are found in some parts of the banks along the Laoag River and the alluvial fan complex. Situated on these natural levees are the poblacions of San Nicolas, Sarrat, Solsona, and Laoag City.

(7) Old River Channel

When the main river is flooded, flood water tend to flow along the old river channels. Many old river channels are found in the alluvial fans of the Solsona, Madongan, and Papa Rivers. The flood plain of the lower reaches of the Laoag River have old river channels also. Daorao creek which is draining Laoag City urban area is one of the old river channel of the Laoag River.

(8) Riverbed and Sand Bar/ High Water Bank

Riverbed and sand bar/high water bank compose the present river channel. The high water bank, which is 2 to 5 meters higher than the riverbed, is easily flooded by a 2-year flood.

1.3.3 River System

The six principal rivers of the project area (Laoag River Basin) are the: Laoag, Bongo, Cura/Labugaon, Solsona, Madongan, and Papa. Laoag River and the lower part of Bongo River flow through the alluvial plain. The other rivers (tributaries) and the upper part of Bongo River flow through the alluvial fan.

(1) Riverbed Materials

Riverbed materials are categorized as (1) large cobble/small boulder, (2) very coarse pebble/small cobble, (3) medium/coarse pebble, (4) very fine/fine pebble, and (5) sand. Large cobbles and small boulders are only found in the fan apexes up to the middle fan reaches. Riverbed materials of the Laoag River is 33% sand.

(2) Flood Carrying Capacity

The Laoag River Basin is frequently flooded due to its small flood carrying capacity as indicated in the following table. Except for the Papa River, all the rivers are easily flooded by 25-year flood without any dikes. Laoag City, which can easily be flooded by a 2-year flood, is protected by a high riverbank at the central part.

River	Discharge(m^3/s)	Return Period (year)
Laoag	2,000 - 5,000	2 - 4
Bongo	500 - 2,000	5
Guisit	500 - 1,000	2 - 10
Cura/ Labugaon	500 - 2,000	1 - 10
Solsona	1,000 - 1,300	25
Madongan	2,000	25
Papa	1,000 - 1,500	100

Note: Return period is the average interval in years within which a given event will be equaled or exceeded.

(3) Existing River Structures

Presently, structures can be found along and in the river channels. These include: (1) river control structures such as dikes, spur dikes, and revetment; (2) irrigation facilities such as diversion dams, pumping stations and brush dam; and (3) transportation related structures.

The largest river control structures in the basin are dikes constructed between 1991 to 1993 along the Solsona, Madongan, and Papa rivers as part of INIP I project, although they are regarded as temporary ones from the structural aspect.

1.4 Hydrology

Hydrologic information, especially the flood data, are very important for this project. Knowledge on the present water quality characteristics of the rivers is also important.

1.4.1 Historical Flood Records

Historical data on flood observations were done for the Laoag River by taking the water levels at Gilbert Bridge for the past 37 years (1959 - 1996). Based on the recorded peak water levels, peak discharges caused by various typhoons with different return periods were estimated. The

data showed that the peak discharge (10,900 m^3/s) of a 25-year flood is only 28% more than the peak discharge (8,500 m^3/s) of a 9-year flood.

1.4.2 Probable Flood Discharge

The probable flood discharges and hydrographs of the Laoag River basin was estimated using the modified rainfall pattern of Typhoon Gloring (1996 occurrence). This particular typhoon was selected by the Study Team since there are no hourly rainfall distribution records available except for this typhoon and its total rainfall depth is large enough. The data showed that the peak discharge (8,900 m^3/s) of a 10-year flood is twice that of a 2-year flood for Laoag River.

1.4.3 Water Quality

Survey on the water quality characteristics of the Laoag River basin and Daorao creek of Laoag City was conducted from 9 February to 9 March 1997. Water samples were collected from ten (10) sampling stations. The parameters analyzed are pH, water temperature, conductivity, total phosphorus, BOD, total dissolved solids, total suspended solids, nitrate, oil and grease, dissolved oxygen, salinity and total coliforms.

Almost all the parameters analyzed are within the DENR standards. The rivers of the Laoag River basin consistently showed low values of the analyzed parameters. Results of the water characterization confirms that the water qualities of these rivers are still within the values of the parameters set for Class A waters. However, Daorao creek registered relatively high values of the parameters analyzed. Compared with the rivers of the Laoag River basin, the creek is considerably polluted.

Results of the detailed water quality study are presented in Attachment I.

1.5 Oceanography

The oceanographic information relevant to the project are the presence of the sand dunes and the tidal water levels of the river mouth. As previously discussed, the mouth of the Laoag River is always clogged during the dry season and easily opened at an early stage of a large flood.

Sand dunes are present at both sides of the river mouth and along the coastal line extending over 1.5 kilometers. It is usually thought that a shoreline is a dynamic system that involves input of sediment from various sources. Normally, much of the sediment is derived from the land and delivered to the sea by major rivers. The Laoag River system is in this case. However, previous study on these sand dunes by the Bureau of Mines and Geosciences (Miranda, 1997) was not extensive and did not produced any quantitative values for the rate of sediment movement.

Variations on the tidal water level at the mouth of the Laoag River, as presented below, were estimated based on the datum line of the National Bench Mark and the data from NAMRIA (1996). The estimated mean sea level is - 0.302. Information of the other tidal water levels are presented in the following table.

Water Level	Elevation
Mean Spring Higher High Water	+0.134 m
Mean Higher High Water	-0.018 m
Mean Sea Level	-0.302 m
Mean Low Water	-0.586 m

1.6 Air Quality

Presently, most parts of the Laoag River basin are still rural in character. Air pollution is therefore not a problem. Data from the DENR showed a Total Suspended Particulates (TSP) concentration range of 69 to 99 µg/NCM in 1996.

Expected concentration ranges for SO_2, NO_2, and TSP of the basin based on the consultants' experience are found in the following table.

Parameter	Ground Level Concentrations Range
SO_2	6-12 µg/NCM
NO_2	3-15 µg/NCM
TSP	25-135 µg/NCM

1.7 Vegetation

The proposed project sites lie in existing rivers where there are existing dam infrastructures. The vicinity of these damsites are mostly developed rural areas where roads and irrigation canals have already been installed. Due to these, vegetation around the damsites and its vicinity vary but similarity is very close.

To determine the characteristic vegetation at the primary impact zone, plant samples were randomly collected at identified vegetation patches in the project site. These samples were classified and identified through the use of available references. Final confirmation has been done through samples kept at the National Herbarium/Botany Division of the Philippine National Museum.

The study indicated that there are no dipterocarp trees were found in the identified primary impact zone. Seventeen (17) species of plants were identified around the proposed damsites and none of these were considered threatened, endangered or rare species. These are presented in Table F.1.1. Of the 17 species of plants identified in the study area, 11 were non-dipterocarps, 4 species of bamboo, and 2 species of grasses. There is relatively low species diversity in the study area. Interview with local people within the project site indicated that the area is utilized as irrigation damsite for a number of years already.

The characteristic plant species of the primary impact zone were considered similar in most vegetated sections within 5 kilometer radius. This could be attributed to the morphological and physiological responses of the plants to climate. The homogenous climatic condition in most sections of the study area has caused very minimal observable biodiversity patterns attributed to low altitude and low soil fertility. Twenty four species of plants were identified outside the primary impact zone, within 5 km radius of the project site. Of this number, 19 species were non-dipterocarps, three bamboo and two grasses. The difference in diversity among these sites is very small and may be attributed to domesticated species of plants cultivated by residents around the existing damsites.

Ocular inspection within 10 km radius of the proposed project sites indicated that the floral composition of the area is mostly of secondary growth vegetation. This could be attributed to existing land use. As farmer's lots abound in the vicinity of the dam sites, vegetation patches in the residential sites are mostly domesticated plants of medicinal and ornamental value.

Observations noted around the vicinity of the irrigation service area indicated that there are reforestation activities taking place as evidenced by the Ipil-ipil, Gmelina, yellow acacia, and eucalyptus trees planted on the roadsides.

Identification of terrestrial plant species found in the study area revealed that most of the samples were considered to have either medicinal or construction value aside from being edible for human consumption. However, the abundance of these species are rather low as they are found only in patches within the project site. This low abundance of economically important plant species is expected as the project area is considered a secondary growth vegetation.

Along the rivers identified as sites for the proposed river improvement plan, the most conspicuous features of tropical communities are the vast areas occupied by floating vegetation. This may take the form of free-floating types or of sud and meadow forming varieties. The same types of small free-floating plants tend to recur through out the river ecosystem. Principal among these are water hyacinth and kangkong which form extensive mats which choke waterways induce deoxygenated conditions. Water hyacinth can double in number every 8-10 days in warm nutrient rich waters.

Observations within the proposed sabo damsites revealed that the most dominant benthic plant species are the filamentous algae Lyngbya sp. However, these algae growth is found only in slow-flowing rivers and by the edges of the riverbanks where water movement is slower. Project sites where algae growth are found include Labugaon River, Solsona River, Papa Dam, Kauplasan River/Bridge and Gilbert Bridge.

Based on the vegetation survey conducted and available secondary information, no threatened, endangered or rare species of plants are identified in the project site.

1.8 Fish and Wildlife

From fisheries viewpoint, perennial rivers may be classified into two major classes, reservoir and flood rivers. Reservoir rivers have stable flow throughout the year and fish communities of such systems are diversified with trophic specialization and well-defined food webs. These differ widely from the communities of flood rivers, behaviorally and dynamically, in that they tend resemble the populations of lakes rather than those of seasonally flowing waters.

The Laoag River and its tributaries can be considered flood rivers which exhibit large seasonal variations in rainfall over the basin which are transmitted downstream as a pulse of increased flow. As a result of this, lateral plains around the Laoag River have been formed which are submerged by overbanking from the main channel. The great fluctuations in level cause a seasonal cycle of flood and drought over much of the area, although a core of permanent water does persist within the main river channels and the low-lying depressions of the floodplain itself. Extreme changes in water chemistry and primary production also occur throughout the cycle, giving rise to a constantly shifting pattern in the variety of ecosystems which make-up the river-floodplain complex. Organisms inhabiting these types of systems have had to adapt to spatial and temporal fluctuations which are perhaps unique in aquatic environments. The constantly shifting bed of the river, and the silting of old features and cutting of new ones, lead to the maintenance of the characteristically flat plain, while producing constant modifications in the detailed geography of the area. Sedimentary material brought downstream by the river is deposited at various places, the material is eroded by the lateral migration of the river channel in its valley and by the scour arising from flow over the surface during floods, forming bedrock boulders around the existing irrigation damsites.

The chemical composition of the Laoag River depends on a wide variety of physical, chemical and biological features. However, three basic mechanisms control surface water quality. These are precipitation, the nature of bedrock and the evaporation-crystallization process. In most tropical rivers, the ionic composition of water derives primarily from the rain and the rock or sediments over which the river flows.

The degree of insolation, substrata composition, turbidity, ground- or rainwater inflows, wind, and vegetation cover, can all influence the temperature of water in rivers and floodplain lakes.

Generally, surface water temperatures follow the ambient air temperature closely, although under dry hot conditions, this is more likely to be correlated with air temperature minimal owing to the cooling effect of evaporation. An annual cycle in which the dry season temperatures are higher than those in the wet season is common. At low latitudes river temperatures are seasonally and diurnally stable, but at higher latitudes, temperatures fall sufficiently and vary to cause fish mortality. Water in the main channel of the Laoag River rarely stratifies as good mixing is maintained by the turbulence associated with river flow.

Conductivity is a measure of the total amount of ions present in a body of water and is therefore useful approximation to chemical richness. As a measure, however, it does not give an indication of the actual ionic composition of the water, and may therefore fail to convey information on limiting factors such as the lack of essential nutrients.

Differences in water type including pH, lead to variations in the fish species inhabiting various waters. In particular, distinctive communities are found associated with highly acidic waters. Savanna rivers are usually neutral or slightly alkaline. Because there is decaying vegetation in standing waters of the floodplain, slight gradients with higher pH values at the surface often exist. Gradients in pH also exist in water's edge where the newly flooded soil may produce either a local drop in pH. Experimental evidence confirmed that cow droppings raise the pH of water rapidly. However, the effects of these are temporary and more acid conditions are quickly restored.

The distribution of dissolved oxygen within the aquatic system is one of the main factors influencing the distribution of fish. As floodwater invade the floodplain, there is an initial rise in dissolved oxygen concentration but these fall swiftly as submerged vegetation begins to decay and only the later rise again to the higher levels maintained during the flood season.

Due to variations in physico-chemical characteristics of the Laoag River and its tributaries, inland fishery production in these areas are very low, in addition to boulder bedrock formation which prevents a favorable habitat for fingerling growth. Further, no considerable population of fish were noted during ocular inspection in the shallow and clear waters. Freshwater species of fish reported by the local people includes Catfish (*Clarias batrachus*), Eel (*Anguila pacifica*), Gorami (*Trichogaster tricopiherus*) and Tilapia (*Tilapia nilotica*), Biya (Goby), and Bangus (milkfish).

Wildlife is likely affected by the past and existing land use in the area. Due to site utilization as irrigation dam, no wildlife has been identified in the proposed project sites. Likewise, no endangered, threatened or rare species of animals have been identified in these areas.

No significant bird population was noted in the identified primary impact zone. No bird calls were observed along the main roads. However, local residents have noted Cuckoo (Kakok), pigeon (Balud), pipit (Oriole), crow (Uwak), rails (Tikling), maya (Bilit China), quail (Pugo), wild chicken (labuyo) and matinez. Available secondary information indicated that there are no threatened, endangered or rare species of birds identified in the project sites.

Relatively little information is available on benthic fauna of slow-flowing, silt-laden rivers associated with floodplains. If this situation exist, it indicates a generally poor fauna consisting of a relatively small number of species. Studies conducted elsewhere indicated that the benthic fauna diminishes in diversity and abundance as the current slows.

On the floodplain itself, where seasonal desiccation occurs small densities of pulmonate snails and clams are present at the bottom and surface of inundated areas.

1.9 Land and Resources Use

The Laoag River Basin covers an area of around 1,330 km^2. Its present land use is dominated by mountain area which is 70% of the total and followed by cultivated areas (18%). The

riverbeds is only 4%. The remaining 8% are residential areas, lowland tree area, bush/grass land, riverwash area, and road/canal/creek areas.

1.9.1 Soil and Land Capabilities

Land may be described in terms of its resource elements and support activities. The capacity to provide outputs, goods, and services is directly related to the ability to manage and protect these various resource elements and support activities.

Based on the soil classification standard set by the Bureau of Soils along the Cura River (Solsona and Dingras), the soils are formed mainly from alluvial or sediment deposits. The texture of the surface soils vary from clay to clay loam with brown to pale brown in color. The soil types are grouped in the Bantog and San Manuel series. The areas along the river are relatively flat and considered as the most productive lands of their respective localities.

The type of soils in the area are prone to erosion because these are structurally weak and unstable. Hundreds of hectares have already been lost through riverbank erosion. River overflows in the past have also caused the surface erosion even in the flat areas.

The land capability grouping is considered a combination of croplands and pasture land. These lands are suitable to all crops commonly grown in the locality. Land management requires only conventional farming inputs to make it productive. Occasional river overflow is a major problem in the nearly level or depression areas. Some farmers instituted overflow protection measures such as appropriate cropping systems to overcome the problem. Rice is best suited in this areas. However, other crops may be planted through proper choice of cropping patterns and conservation practices.

In the past, the lands along the river are major settlement areas. Settlers stay close to the riverbanks since the river is the major source of water for domestic purposes. In addition, the river is also a good source of fish.

1.9.2 Vegetation and Crops

Vegetation on the area varies with productivity and preferences among the settlers. In the croplands, the following crops are grown: rice (1-3 cropping per year), corn, peanut, mungbeans and other beans, tomato, cassava, eggplant, squash, water melon, singkamas, pepper, tobacco, garlic, onion.

Permanent crops and vegetation are interspersed within the settlement areas as part of their "home gardens". The commonly found permanent crops with economic importance are: mango (carabao and hawaiian), avocado, tamarind, santol, chico, cashew, banana, and pomelo. Forest species such as the different species of bamboo, agoho, auricauliformis, mahogany, eucalyptus, and Gmelina are also found.

1.9.3 Farm Systems

Agricultural crop production is the major use of the lands along the rivers. Rice planting is 1 to 3 cropping every year. Three cropping is practiced in irrigated areas, especially those cultivated by the tenants, since the landowners do not ask for a share of the second and third cropping from these tenants.

Generally, the cropping pattern is rice-based with an all year round crop production. In the irrigated areas, the common cropping patterns are rice-vegetables-corn, rice-rice-vegetables, rice-rice-beans, rice-rice-rice. Cropping in the rainfed or unirrigated lands is more intensive and the type of crops grown are more variable. Farmers can grow more high value crops which can command higher income than rice. The common cropping patterns are rice-bean-vegetables,

rice-vegetables-corn. Inter-cropping is a common practice especially those in the well-drained areas, such as corn and peanut, vegetables and corn, beans and corn.

Rice is grown from July to September or October. The last rains of October and November can still sustain the crops following rice. The third cropping after rice are irrigated through overhead irrigation. Water is drawn from the river or shallow well (20 ft) through water pumps (5 to 7.5 HP). About 40% of the farmers in the locality own a water pump.

The irrigation systems of NIA has managed the water requirements of the farmers in the area. Some farmer groups still maintain the "Zanjera" especially those that cannot be serviced by the NIA projects.

1.9.4 Land Ownership Inventory

Lands along the river are privately owned. These are cultivated either by the owners themselves or their tenants. Many of these properties have portions lost to the widening river. Nevertheless, the owners still continue to pay their land taxes in the hope of retaining their ownership of the lost portions and thinking that they can use the area as quarry sites for aggregates. Present land values in the town of Solsona is around 25 to 60 pesos per square meter, while in the town of Dingras it is around 60 to 100 pesos.

1.9.5 Property Rights in Changing River Courses

Property ownership issues regarding the changing course of a river or its widening are clearly resolved by the Philippine Civil Code. Rivers are properties of public dominion (ownership of the state) since they are intended for public use as provided for by Article 420 of the Civil Code. Whenever a river, changing its course by natural causes, opens a new bed through a private estate, this bed shall become of public dominion (Article 462). The Supreme Court also ruled that the new river banks shall likewise be of public dominion.

River beds which are abandoned through the natural change in the course of the waters belong to the owners whose lands are occupied by the new course in proportion to the area lost. However, the owners of the lands adjoining the old bed shall have the right to acquire the same by paying the value which shall not exceed the value of the area occupied by the new bed (Article 461).

Article 461 of the Civil Code also applies to cases where the new river bed is itself abandoned because of another new change of course. In this case, the owner of the land flooded by the new change of course would own the newly abandoned river bed. However, if the river goes back to its old course (flooding the original bed), the owner of the land originally flooded would get back the ownership of the land that he had lost.

1.10 Socio-economic Aspects

Baseline information on the socio-economic aspects were obtained from various sources such as (1) interviews with key informants who are persons considered knowledgeable on the social services and environmental problems in the area, (2) various government agencies, and (3) the conduct of a sample survey using a household questionnaire in six barangays of the direct impact area. Results of the detailed socio-economic study are presented in Attachment II.

The most interesting socio-economic data is the flood experience of the people. Around 90% of the households in the surveyed barangays have experienced the flood in 1996 with an average flood water depth of 0.8 m in front of each house which lasted an average of 3.8 days.

Only very few households escaped from the damage brought about by the flood. The children were the first to suffer with 62% of the households having at least one child absent from school with an average absence of 4.3 days. A damage of the house is being sustained by 47% and the

farmland itself by 43 percent. Hence, the survey revealed the peoples aspirations of someday getting a relief from the disastrous annual flooding.

CHAPTER II FUTURE ENVIRONMENTAL CONDITIONS WITHOUT THE PROJECT

2.1 General

Comparing the future conditions without the project against those conditions where the project is implemented is essential for weighing the project's benefits against its impacts. Hence, the future environmental conditions without the project are presented in this chapter.

2.2 Climate

Considering the available data, no sudden changes in the micro-climate could be expected in the project area for the next five years. Gradual increase of local temperature is not expected since urbanization is not rapid. The basin would remain largely rural in character such that no significant changes in the environment is expected which may result to changes in temperature, wind direction and speed, etc.

2.3 Geology and Terrain

Without the proposed project, the basin is likely to remain the same for the next five years. There will be no changes in the topographic, physiographic, or geologic features of the area. The physical and chemical characteristics of the soil in the area are likely to remain the same.

2.4 Hydrology

Without the project, stream flow would remain the same if there are no activities in the watershed. If DENR will continue its reforestation program, stream flows will have less sediment load. Any continued deforestation activities will surely affect the stream flow and possibly increase the sediment load.

2.5 Oceanography

With regards to oceanography, no significant change in hydrography is expected. The basin will continue to deliver a large amount of sediments to the coastal zone.

2.6 Air Quality

Air quality within the project site is expected not to change even without the project. It is projected that the presence of industrial sources emitting air pollutants will not drastically increase in the future.

2.7 Vegetation

Vegetation cover in the proposed project site is likely to remain the same without the proposed sabo dams. During dry summer months vegetation will exhibit withering due to limited amount of water. However, during the rainy season, growth will then be enhanced due to availability of water. However, during occurrence of floods, more siltation is likely to occur without the sabo dams.

The number of ornamental plants cultivated by the residents around the existing damsites will remain the same even without the proposed sabo dam project. This ornamental plants are likely to increase due to the present government campaign of community clean and green program.

2.8 Fish and Wildlife

The whole stretch of the Laoag River and adjacent tributaries will continue to have limited fish and wildlife population due to past and present land use. The present limited number of fingerlings observed around the existing damsites will remain as there is very limited nutrient available in the area.

The existing vegetation cover around the existing dams are likely to remain and may not be able to support wildlife species due to scarcity in number.

2.9 Land and Resource Use

The mountain and cultivated areas will remain the dominant land uses of the basin. The annual impact of flooding will still restrict the economic development of the area, particularly the high flood intensity areas.

The issues regarding the changing river courses will still affect the property rights in areas along the rivers.

2.10 Socio-economic Aspects

Without any major socio-economic inputs to the area, the present socio-economic conditions is expected to change slowly. There will be slow changes in such factors as population densities, employment situation, and housing facilities. However, the transportation and communication facilities will improve considering the invested resources in the area. Although the people in the outlying areas will continue to have rural lifestyles, the increasing influence of city life will be felt because of the proximity of these areas to Laoag City which is becoming more urbanized.

CHAPTER III ENVIRONMENTAL IMPACT ASSESSMENT

3.1 General

A systematic identification, prediction, and evaluation of the project's potential impacts to the environment is presented in this chapter. Analyses were made on the potential impacts during construction and operation phases. Although project abandonment is quite remote, any abandonment decision in the future can easily be carried out since the project's construction materials are only concrete, steel, and aggregates. There will be no decontamination activities since toxic and hazardous wastes will not be present.

3.2 Assessment Approach

Analysis of the project's possible impacts to the environment was made by recognizing that the construction phase would mainly be site development and the construction of small concrete structures along the river banks and within the riverbeds, while the operation phase would be the use of these passive concrete structures. The analysis presents the effects of the unmitigated impacts. The necessary measures to reduce or eliminate the impacts will be discussed later under the Environmental Management Plan (EMP).

Identification of the potential environmental impacts was done comprehensively by evaluating the project's features and operations against the known list of potential impacts identified by various sources for this type of project.

Results of the impact analysis are presented in the form of a scaling checklist which indicates the nature of likely unmitigated impacts and their predicted significance.

Basic Difference of Sabo Dams

Environmental effects of water impounding projects have long been recognized. In fact, considerable attention has been given to these effects in the design of small dams (USDI, 1974). Most of the adverse impacts associated with dam projects are caused by large dam structures with the associated large water impoundment. Hence, environmental assessment guidelines prepared by international financing institutions such as the Asian Development Bank and the World Bank have given heavy emphasis on major dam projects. These guidelines recognized that the construction and operation of large dams are the principal sources of impacts in hydropower projects. This is not the case for this project.

An important consideration in the assessment of the impacts of the sabo dams is its inherent function as a sediment trap and not as a water impounding structure. Its volume of impounded water is quite small and will eventually represent only the void spaces of the sediments which is around 35% of the sedimentation volume for this project.

3.3 Construction Phase Impacts

Potential impacts during the construction phase are associated with the construction of the various structures. Most of these are short-term in nature. Identified potential impacts are presented in the following table.

Impact Field	Direct Impact	Nature	Magnitude
Ecology	Fish and Wildlife Disturbance	Negative	Minimal
	Vegetation Loss	Negative	Minimal
Water Quality / Air Quality / Noise	Water Pollution	Negative	Moderate
	Air Pollution	Negative	Minimal
	Noise Generation	Negative	Minimal
Geology	Soil Erosion	Negative	Minimal
Social-Economy	Land Acquisition / House Relocation	Negative	Minimal
	Archaeological / Historical Asset Loss	Negative	No Effect
	Traffic Disturbance	Negative	Minimal
	Local Labor Employment	Positive	Significant

3.3.1 Fish and Wildlife Disturbance

No threatened, endangered or rare species of fish and wildlife are identified in the present project area.

During construction, a small number of fishes, wild animals and birds near the construction sites will be affected. However, this impact is expected to be only during construction period and normal conditions will be restored after construction. Therefore affected fishes, animals and birds will be restored in their natural habitat after sometime.

3.3.2 Vegetation Loss

No threatened, endangered or rare species of plant and vegetation are identified in the present project sites.

Although most of the identified plant species in the primary impact zones of the project are considered economically important, the density of the affected species is considerably small as these are found only in patches within the project area. Most of these plant species are grasses, weeds and non-dipterocarp. No significant negative impact are expected in terms of vegetation cover since only a small section of the project site will be prepared for the structures.

3.3.3 Water Pollution

Water pollution sources would be the dewatering work for structure foundations, earthwork operations adjacent to a stream, and aggregate processing. However, water pollution due to these works is considered not significant since the riverbed materials of the project sites are mainly composed of sand, gravel and boulder but includes very little silt and clay.

3.3.4 Air Pollution

Air pollution would come from the use of heavy equipment and dust generation activities. Nevertheless, this will not be a nuisance to the public since houses are relatively far from the construction sites.

3.3.5 Noise Generation

Operation of the various construction equipment will be the major source of noise pollution during construction. Construction equipment such as backhoes, cranes, and jack hammer have a range of 72 to 95 dB (Canter, 1977). However, this noise would not be a nuisance to the public since houses are far from the sites.

3.3.6 Soil Erosion

Soil erosion may occur due to earth excavation works as on strip vegetation cover at the site. In this project, the earth excavation site are limited to the riverbeds and abutments of sabo dam. The excavation in the riverbeds will not cause soil erosion. On the other hand, the abutments of the proposed sabo dam are formed of hard rock and there is little soil cover there. Hence, the impact to soil erosion is considered minimal.

3.3.7 Land Acquisition / House Relocation

The required land acquisition and house relocation for the project are estimated as follows.

Item	Project Area	Laoag-Bongo River	Alluvial Fan River	Sabo Dam	Total
Land Acquisition (ha)		26.0	10.0	1.5	37.5
Farm/Bush (ha)		25.2	10.0	1.5	36.7
Residential Area (ha)		0.8	-		0.8
House Relocation (nos)		3	-		3

These land acquisition and relocation of houses are considered small compared to the beneficial land area and population of the project.

3.3.8 Archaeological / Historical Asset Loss

No stone age remains have been found in Ilocos Norte. Some Chinese historical properties in Tang, Sun, Yuan and Ming ages have been found along the coastal areas. No historical site in the direct impact area is registered in the National Historical Institute. However, there are fine specimen of Spanish Baroque Churches in the project area. One is Sarrat Church and the other is the ruins of Old Dingras Church. These will not affected by the construction works.

3.3.9 Traffic Disturbance

The existing traffic volume of the project area is small. Most of the construction works will be performed within the river area. The impact on traffic is considered small.

3.3.10 Local Labor Employment

Construction activities for the various structures will definitely require a large number of workers. Estimated labor employment during the construction phase are about 902,000 man-days of common labors and 515,000 man-days of skilled labors or equipment operators.

If the labors are recruited from the vicinity of the proposed project site, the positive impact will be significant. Out-migration may be reduced because the job opportunities will serve as an attraction for the potential migrant to stay. The salaries and wages paid to the persons who will be employed will increase the capability of the householders to support their dependents. The earning salaries or wages will spend for their living expenses such as procurements of foods, clothing, education, transportation, etc. It results a secondary positive economic impact in the local communities.

On the other hand, if the great numbers of labors are recruited from outside and they reside in the construction site, the short term population pressure will occur in the local communities. The negative impact to the local communities may occur in social services and housings. The labors recruited from outside will remit most of their earning money back to their families

which causes the less funds going into the local economy. The contractor will surely use the available local labor for their construction activities.

3.4 Operation Phase Impacts

Potential impacts during the operation phase will be primarily due to the presence of the sabo dam as a barrier in river. The proposed two (2) dams, namely Labugaon No.1 and Solsona No.1 sabo dams will be constructed on rock foundation. Other three (3) dams namely Cura No.1, Madongan and Papa sabo dams will be constructed as a floating type of dam on the thick sediment deposit.

The proposed project is checked against the list of potential impacts for this type of project as discussed previously. This approach makes a comprehensive evaluation of the impacts that the project are likely to generate. Identified potential impacts are presented in the following table.

Impact Field	Direct Impact	Nature	Magnitude
Hydrology/Fluvial Hydraulics/ Erosion	Groundwater Recharge Reduction	Negative	Minimal
	Riverbed Aggradation	Negative	Minimal
	Reduction of Channel Shifting	Positive	Significant
	Increase of River Bank Erosion	Negative	Minimal
	Decrease of Sand Supply to coast	Negative	Minimal
Water Quality/ Air Quality/Noise	Generation of Water Pollutants	Negative	No Effect
	Generation of Air Pollutants	Negative	No Effect
	Generation of Noise	Negative	No Effect
Geology	Geological Destruction	Negative	No Effect
Ecology	Loss of Wildlife Habitat	Negative	No effect
	Disruption of Fish Spawning Grounds	Negative	Minimal
Aesthetics	Aesthetic Impairment of Landscape	Negative	Minimal
	Visual Impairment of Historical/ Cultural resources	Negative	No Effect
Natural Resources Use	Loss of Fishing Area	Negative	No effect
	Impairment of Navigation	Negative	No effect
	Damage to Economically Valuable Natural Resources	Negative	No effect
Socio-economy	Reduction of Economic Loss	Positive	Significant
	Reduction of Health Risk	Positive	Significant
	Increase of Available Farmland	Positive	Significant
	Disruption of Minorities' Life	Negative	No Effect

3.4.1 Hydrology, Fluvial Hydraulics and Erosion

(1) Groundwater Recharge Reduction

Labugaon No.1 and Solsona No.1 sabo dams will be fixed on rock foundations. Hence, they will block the sub-surface water of the rivers and convert it to surface water. The converted sub-surface water will naturally be taken from the existing downstream irrigation intakes. This will decrease the existing groundwater recharge in the

downstream alluvial fan areas. However, the convertible sub-surface water volume is estimated at a small as 5 l/sec in total. Hence, the reduction of groundwater recharge is considered negligible.

(2) Riverbed Aggradation

Floods of the Cura/Labugaon, Solsona, Madongan and Papa rivers widely deposit sediments on the lands of the alluvial fan area at present. The confinement of the floods by the dike construction will aggradate the riverbeds of the above rivers. On the other hand, the proposed sabo dams will decrease the sediment runoff to the rivers, resulting in degradation of the riverbeds.

The river bed aggradation of the above rivers after 20 years is predicted to be in the range of nearly zero in Madongan River and 80 cm in Solsona River, averaging 30 cm. However, this aggradation will not cause flood since the proposed dikes are designed to meet this aggradation. Further, the adverse effects of this riverbed aggradation on the existing irrigation intakes are considered minimal.

(3) Reduction of Channel Shifting

Presently, large size sediments are much deposited in the fan apexes of the above rivers at a big flood time. This usually disturbs the flood flow and shifts the channel course. However, the proposed sabo dams will decrease the deposition of large size sediments at the fan apexes, resulting in reduction of channel shifting. These positive effects are considered significant.

(4) Increase of River Bank Erosion

The confinement of floods by the dike construction will increase the sediment transport capacity in the rivers, resulting in the increase of bank erosion at some critical sites. On the other hand, the proposed spur dike construction will mitigate the flood flow velocity near the river bank and induce sediment deposition there. Therefore, river bank erosion will be minimal.

(5) Decrease of Sand Supply to the Coast

The existing sand dunes along the coast are formed by a portion of the sediments supplied from the Laoag River. The existing average annual sediment runoff to the sea is estimated at approximately 100,000 m^3. On the other hand, the proposed sabo dams are expected to reduce the sediment runoff to the sea by 3,000-5,000 m^3 per annum on an average. Therefore, the impact to the sand dune formation is considered minimal.

3.4.2 Water Quality, Air Quality and Noise

The project will not generate water pollution loads, air pollution loads and noise during the operation phase.

3.4.3 Geology

No large scale geological destruction is expected during operation phase, since the sediments/water storage area and depth of the proposed sabo dams are small.

3.4.4 Ecology

(1) Loss of Wildlife Habitat

There is no wildlife habitat in the proposed sabo dam and river structure sites.

(2) Disruption of Fish Spawning Grounds

The proposed sabo dams will prevent fishes from going up the rivers. However, there

are few fishes in the upstream of the alluvial fan rivers and they include no threatened, endangered or rare species. The disruption of spawn grounds of fishes is considered minimal.

3.4.5 Aesthetics

(1) Aesthetic Impairment of Landscape

The proposed sabo dams and dikes may reduce the aesthetic appeal of landscape in the project sites. On the other hand, the sabo dams will create new landscape with artificial water falls. The river water will constantly spill over the crest of the sabo dams. The impairment of total landscape is considered minimal.

(2) Visual Impairment of Historical and Cultural Resources

The objective historical and cultural resources are the Spanish Baroque Church in Sarrat and the ruins in Dingras. No river structures are proposed in Sarrat. The proposed dikes in Dingras is small and far from the site of the ruins. The project will not cause adverse impact on the aesthetics of the historical and cultural resources.

3.4.6 Natural Resources Use

(1) Loss of Fishing Area

Disruption of fishing activity may occur during the construction phase, but fishing may resume during the operation phase.

(2) Impairment of Navigation

There are no navigation activities in the project area.

(3) Damage to Economically Valuable Natural Resources

The project will cause no damage to the other economically valuable natural resources.

3.4.7 Socio-economy

(1) Reduction of Economic Loss

The project will reduce the existing flood damages on house buildings, household effects, commerce and industrial properties, physical and social infrastructures, agricultural products, etc.

The project will extend the life span of public infrastructure and will eliminate the flood-caused disruption of the delivery of social services. The flood has caused destroying roads, cutting bridges and rendering useless of the school buildings and health centers. The destruction of these infrastructures means more expenses on the part of the government. Thus the project will save the government money spent on the rehabilitation and replacement of infrastructures.

Reduction of economic loss and increase of local economy will also contribute to the revenue of local government units.

(2) Reduction of Health Risk

Many people in the flood prone area obtain drinking water from dug wells and are provided with unsanitary toilet system. The drinking water is contaminated and toilet wastes overflow every flood time. The project will reduce such health risk.

(3) Increase of Available Farmland

Approximately 50 ha of farmlands is washed away every year in the project area under the present situation. This land loss will be prevented by the project. On the other hand, the project is expected to restore the existing devastated lands of about 1,800 ha for grazing, upland crop or rice cultivation.

(4) Disruption of Minority's Life

There are some cultural minorities called Isneg in the project area. They are concentrated in the municipality of Carasi which has a total population of 750. Half of the population are Isneg. Their economy mainly relies on slush and burn farming although they mostly live along the rivers which serve as a main source of food. However, many Isneg are no longer farmers and many have established themselves in various occupations through formal schooling.

The project will install a sabo dam in Carasi. The construction of the sabo dam may temporarily displace the existing fishing activities. However, in the long-term the project will have no impact on their life style.

3.4.8 Additional Considerations on Potential Risk of Dam Break

Unlike a dam that functions as a water reservoir, a sabo dam has a very low possibility of breaking and will not cause a disastrous situation in the event of failure. This is possible due to a very low dam height and a small water impounding volume. A sabo dam, as previously discussed, is not a water impounding dam. Its main function is to capture the sediments. A water impounding dam has a very high potential to cause a downstream disaster compared to a sabo dam due to its very high energy potential supplied by the impounded water.

Despite the low risk potential of a sabo dam, the scenario of a dam break situation was studied for this project.

(1) Possibility of Dam Break

Dam break in a sabo dam could be due to a dam damage caused by the passage of debris flow. A debris flow could have treniendous destructive energy because of the massive movement of big boulders and gravel. However, debris flow may only occur in a steep valley with a slope of more than 25%. When this occurs, this type of flow will rush down through a channel with a slope of 7% to 25%. Then it will start depositing on the riverbed with a slope of less than 7% and may reach the channel with a 3% slope.

Fortunately, the proposed sabo dams for this project are located on a riverbed with a slope of less than 3%. Hence, it is very unlikely that a debris flow may eventually reach the proposed dam sites. The possibility of flood water to damage the structures is also very low since its destructive energy is quite small compared to a debris flow.

In view of the foregoing discussions, the possible occurrence of a dam break is considered very remote. Future damage to some portions of the sabo dam due to serious scouring and collision of big boulders during floods can be avoided by proper design, construction, and maintenance/rehabilitation.

(2) Dam Break Situation

Although the possibility of a dam break is considered very remote, its resulting effect is also being examined by estimating the equivalent thickness of channel aggradation. In this situation, the following may be expected in a worst case scenario:

a) Stored sediment in the dam will be released immediately to the downstream reaches during a sudden dam break;

b) The released sediment will be deposited in the immediate downstream reaches with a steep channel from the sabo dam.

The channel aggradation during dam brake are estimated as follows;

River	Dam Storage (m^3)	Channel Dimension (m x km)	Deposit Depth (m)
Cura	391,000	220 x 1.0	1.8
Labugaon	1,043,000	250 x 2.0	2.1
Solsona	233,000	230 x 3.5	0.3
Madongan	2,192,000	300 x 5.5	1.3
Papa	707,000	220 x 2.5	1.3

The analysis showed that the channels in the immediate downstream reaches have enough capacity to absorb the released sediments from a dam break since the channels have depths greater than 2.0 meters.

CHAPTER IV ENVIRONMENTAL MANAGEMENT PLAN

4.1 General

This section deals with the Environmental Management Plan (EMP). It is the plan on what to do with the potential impacts identified and discussed in the Chapter III "Prediction and Assessment of Impacts". The purpose of the EMP is to enhance the beneficial impacts and to lessen the adverse impacts. The EMP is broken down into the following components:

1) Impact Management
2) Impact Monitoring
3) Institutional/Reporting Plan

4.2 Impact Management

Impact Management shall be implemented against to mitigate the adverse impacts predicted in the assessment.

The water pollution during the construction phase is considered only one (1) moderate negative impact which shall be eliminated or mitigated. The method of riverbed excavation, excavation of structural foundations, dewatering and aggregate processing shall be planned to minimize the generation of turbid water. For this purpose, a settling basin will be provided immediately downstream of the construction site, if necessary.

All the other negative impacts during construction and operation phases are minimal or none. Hence no special environmental management plan is proposed for these impact.

4.3 Contingency Plans

Large-scale contingency plans due to the presence of the sabo dams are not necessary since the proposed sabo dams will not create or lead to hazardous conditions. It is also not a potential direct source of pollutants. Hazards generated in large dam projects are not expected in this project since the proposed dam height is very low and the impoundment volume is very small or zero. As previously discussed, the channels in the immediate downstream reach of sabo dams have enough capacity to absorb the released sediments from a dam break even though it is the very rare and remote possibility. Therefore, the contingency plan regarding dam failures will not be considered.

Presence of the river improvement works should not make the people become complacent about future flooding events. The people and the local government units should be aware that the degree of protection to be provided by this project is based on a calculated risk and not an attempt to provide absolute flood control. It is therefore important that they will understand that floods greater that the design flood (25-year flood) may also occur. In view of this, the LGUs and concerned government agencies should continue their calamities and disaster preparedness planning related to unusually large floods.

4.4 Impact Monitoring Plan

The impact monitoring plan will not be proposed since the project have no significant or moderate negative impacts on the both construction and operation phases except for water pollution on the construction phase.

Water pollution sources would be dewatering work for structure foundations, earthwork operations adjacent to a stream, and aggregate processing. These works would not be a cause of significant pollution loads since the riverbed materials of the project sites are mainly composed of sand, gravel and boulder but includes very little silt and clay.

However, possible negative impacts by the contractor's irresponsible manners shall be monitored in following view points;

1) Construction activities shall not be conducted in such a way of an unnecessary destruction, scarring, or defacing of the natural surroundings in the vicinity of the work. The contractor's camp, shop, office, and yard area shall be located and arranged in a manner to preserve trees and vegetation. Upon completion of the construction, the following shall be implemented, (1) all work areas will be smoothed and graded in a manner to conform to the natural appearance of landscape, (2) all exposed areas will be replanted, seeded, or otherwise corrected, (3) all camps, storage, and construction buildings, including all unused construction materials and debris shall be removed from the site.

2) Construction activities shall be done by methods that will prevent entry or spillage of solid matter, contaminants, debris, and other objectionable pollutants and wastes into the river. Pollutants and wastes refer to the refuse, garbage, cement, concrete, oil and other petroleum products, aggregate processing tailings.

The proponent will closely coordinate with the DENR and the LGUs on the monitoring and reporting activities. For a smooth implementation of the project, the proponent will appoint an Environmental Coordinator (EC) for proper coordination with the DENR and the LGUs.

Although the construction activities are expected not to significantly affect the people, the proponent and its contractor shall quickly address any construction related issues or problems to be raised by the people. This shall be done with the help of the concerned barangay officials. The EC shall actively participate in the resolution of the issues/problems.

4.5 Institutional/Reporting Plan

This institutional/reporting plan discusses the necessary organizational and human resources components in implementing the environmental aspects of the project. Proper coordination between the project proponent, the LGUs and the DENR is very important for a smooth implementation of the project. This will ensure the expeditious action on any environmental issues or problems that will arise during the construction and operation phases of the project. The proponent shall therefore appoint an Environmental Coordinator (EC) who shall be responsible for all environmental matters regarding the project.

The EC shall be tasked with the following:

1) coordinate with the LGUs and the DENR on the environmental aspects of the pre-construction and construction activities of the project,

2) monitoring all activities relative to the Environmental Compliance Certificate (ECC) stipulations to ensure compliance of all requirements,

3) coordinate with the DENR on all environmental monitoring activities,

4) actively participate in the periodic consultations with all concerned sectors on the various environmental impact issues of the project,

5) maintain records on all matters concerning the environmental aspects of the facility,

6) prepare a monthly environmental status report of the project during the construction phase and consolidate these reports for a quarterly submittal to the DENR, and

7) prepare an annual environmental status report of the project during the operation phase.

CHAPTER V SCOPING AND PUBLIC CONSULTATION

5.1 General

This Chapter reports the activities of the DPWH and the Study Team regarding the scoping session, public information and public consultation of the project. The public information and consultation are the latest requirement of the DENR concerning the public participation and social acceptability aspects of the proposed project. These aspects are beneficial to most people directly or indirectly affected by the project.

The Philippines Environmental Impact Statement (EIS) System is based on a series of presidential decrees, executive orders, proclamations, letters of instruction, and implementation rules and regulations. The previous revision to the implementing rules and regulations of Presidential Degree No.1586 was DENR Administrative Order (DAO) No. 21, series of 1992 which provided the set of procedures for the whole process of securing an Environmental Compliance Certificate (ECC). This set of procedures has recently replaced by DAO No. 37 series of 1996 (cited as DAO 96-37) which become effective last January 1997.

DAO 96-37 gives higher importance on public participation and social acceptability in the processing of ECC applications. Public participation is giving citizens the opportunity to influence major decisions that affect them. Its goal is to enable the people to take responsibility for environmental protection and management through active involvement in decision making. DENR believes that public participation is the only process to promote and acquire social acceptability of a proposed project. It will reduce the level of misinformation and distrust. In addition , it will help identify the concerns of affected groups and help focus the planning activities of issues of concern. This expected to result in an improve decision-making process.

5.2 Project Activities

Construction activities are the usual activities associated with earthworks and horizontal concreting projects. These activities include: (1) site clearing, (2) excavation, (3) temporary access road construction, and (4) concreting. Except for cement and steels, construction materials for the concrete structures are readily available in the site. Concrete volume requirement for the sabo dams ranges from 5,200 m^3 to 20,800 m^3 and for the river improvement works ranges from 13,000 m^3 to 16,500 m^3.

Operation and maintenance will not be a problem since the project components are all passive structures. The activities during this phase will focus on the periodic inspection of all structures to insure the early detection of any problems. Structural integrity of the concrete structures will be a primary concern.

Although project abandonment is quite remote, any abandonment decision in the future can easily be carried out since the project's construction materials are only concrete, steel, and aggregates. There will be no decontamination activities since toxic and hazardous wastes will be present.

5.3 Public Information

Since the start of the study, the public was informed both formally and informally. Instances where project information was carried out include: (1) the project presentation, (2) flood damage survey, and (3) socioeconomic and perception survey. In addition, DPWH has requested the cooperation of the Provincial Government on the conduct of the study for the proposed project through a letter to the Governor of Ilocos Norte in June 1996.

5.3.2 Project Presentation

The DPWH and the Study Team provided the project presentation to the various government agencies on last 13 September 1996, where the conceptual plan of the sabo and flood control in Laoag River Basin was presented and explained. Attended representatives of the government agencies were Laoag City Engineer, Provincial Engineer, DPWH Engineering Districts, National Irrigation Administration (NIA), DENR's Ilocos Norte PENRO Office, and the Provincial Planning and Development Office (PPDO).

5.3.2 Flood Damage Survey

Informal public information activities regarding the proposed project were conducted by the DPWH and the Study Team during the detailed flood damage survey. Interviews were made with all barangay captains in the flood prone areas. Every time when the survey team visited a barangay, a brief project presentation was made in the informal meetings. It was explained to the people that the proposed project will use dikes for the flood control of the Laoag River including its tributaries and sabo dams for the controlling the excessive sediment runoff in the downstream reaches of the various rivers. The flood damage survey was conducted for the estimation of probable flood damage in the Laoag River Basin. Data were obtained regarding the flood area, flood depth, affected population, and inventory of existing assets in the flood-prone area.

5.3.3 Socio-economic and Perception Surveys

Another set of informal meetings were initiated by the EIA study team during the conduct of the socio-economic and perception surveys. Meeting were held with the barangay captains of the survey areas. The selected barangays are part of the areas heavily affected by previous floods. Again, the proposed project components were explained during these meetings.

The people were very happy about the proposed project and revealed their aspiration of someday getting a relief from the disastrous annual flooding. Around 90% of the households in the surveyed barangays have experienced the flood in 1996 with an average flood water depth of 0.8 meter in front of each house that lasted an average of 3.8 days.

5.4 Initial Scoping

An initial scoping session was conducted last 13 February 1997 with the Provincial Environment and Natural Resources Office (PENRO) of the DENR at Laoag City, while a separate discussion was made last 24 February 1997 with DENR's Region I Office in San Fernando, La Union. The purpose of the sessions was to get DENR's concerns which should be addressed by EIA study and to be included in the EIS.

5.4.1 Issues and Concerns

The PENRO staff raised the following items during the discussions: (1) schedule of the required community consultations, (2) clear presentation of the socio-economic data, (3) identification of employment opportunities for the local workers during the actual implementation of the project, (4) clear presentation of the various engineering information to be used for the design of the proposed sabo dams, (5) the project proponent (DPWH) should show that the proposed project will not cause an unacceptable erosion of the rivers, (6) clear presentation of the resulting in the event of a dam failure, and (7) identification of the various areas to be protected by the proposed project.

The regional office is happy that a project to protect the people of the frequently flooded Laoag Basin will be implemented. According to the EIA Section Chief, the Regional Technical

Director (RTD) has decided that the ECC application for this project will be processed in the regional office. However, the regional office requires that the project proponent should properly inform the project components to the affected peoples and should consider any valid issue or concerns that they will raise.

Discussions with the PENRO and Regional I Offices shows that DENR is very much interested in the conduct of the community meeting since this will be part of the proofs for a transparent community-based process of public participation. DENR believes that the meeting will improve the social acceptability of the project and will pave the way for a smooth project implementation in the future.

5.4.2 Identification of Stakeholders

Stakeholders, as defined by DAO 96-37, are persons who may be significantly affected by the project or undertaking, such as, but not limited to, members of the local community, local government units, non government organizations, and people's organizations.

The major stakeholders are the people living in the areas to be protected against the annual flooding. Since the project is basin wide in scope, the local government units are therefore the representative of the stakeholders, concerned government agencies are also stakeholders such as NIA, PPDO, DENR, and NEDA.

5.5 Public Consultation

The DPWH sent out invitation for a public consultation meeting regarding the proposed project. The meeting was conducted at the Laoag amphitheater on 30 May 1997. It was attended by the representatives of the stakeholders. Representatives of the Ilocos Norte PENRO Office and the DENR's Region I Office also attended the meeting.

The project proponent was represented mainly by the District Engineer of Ilocos Norte Engineering District I (INED-I). Representatives of DPWH's Project Management Office for major flood control projects and the Study Team were also presented. The DENR was represented by the EIA section chief of the DENR Region-I Office and the senior environmentalist of the PENRO, Ilocos Norte.

5.5.1 Presentation

The various details of the proposed project were presented by the District Engineer, INED-1 to the participants through the use of overhead projector and a big project map which placed in front of the participants. Earlier, small project maps were distributed to the participants before the start of the presentation. Most of the participants in the meeting have already heard of the proposed project, while some have attended a previous project presentation by the proponents.

Important considerations in the planning and design of this project are the selection of the (1) design flood discharge and (2) possible structural measures. The selected design flood discharge is the flood with a 25-year return period. Construction of dikes is the principal selected measure for flood control of the Laoag River including the tributaries, while sabo dams are selected to control the excessive sediment runoff in the downstream reaches of the various rivers. Reforestation is also considered for the effective mitigation of the annual excessive sediment runoff.

The project will be implemented in three phases. The phase I priority project which is the subject of the Feasibility Study and the ECC application are included five sabo dams and seven river improvement works. Total estimated cost of the phase I project is 2,378 million pesos.

5.5.2 Discussion

Everybody were unanimous in saying that the project area is really in need of the project due to the annual flooding experienced by the people. Hence, the proposed project is a welcome relief to this annual flooding problem.

The main issue raised by some LGUs is the non-coverage by the project of some areas in their respective locations. The Mayor of Sarrat asked why only one barangay in his town is included in the first priority projects. The DPWH officials responded by explaining that the selection of the priority areas was based on the flood damage survey and the weight of expected damage on the design flood discharge.

The NIA representative raised the following items: (1) NIA requests DPWH that any new irrigation intakes to be installed under the river improvement works shall be provided without cost to NIA, (2) irrigation intake at San Nicolas and Sarrat should not be affected adversely, (3) NIA also request the improvement of the irrigation lateral canals for Laoag City, and (4) the maintenance issue by DPWH for the previously provided flood protection facilities under the irrigation project. The DPWH officials responded by explaining that the river improvement works will not affected the existing irrigation intakes of the National Irrigation Systems along the Laoag River, while the decision to charge NIA for any irrigation intakes to be replaced or installed under the river improvement works will be decided by the DPWH main office in Manila, and item (3) and (4) are not related to the proposed project.

The National Economic and Development Authority (NEDA) representative informed the body that DPWH should coordinate with the DENR for the reforestation of the watersheds. DPWH was also reminded of the required Environmental Compliance Certificate (ECC) since it will be a requirement when DPWH will request for project funding. The DPWH officials responded by informing the body that DPWH is closely coordinating with the DENR and that this consultation meeting is part of the DENR requirement, while the reforestation component of the project is also being considered. The representative of DENR's Ilocos Norte PENRO Office informed the body that the JICA Study Team is indeed coordinating closely with the DENR. The following items were raised: (1) basis of selecting the Laoag River Basin as the project beneficiary, (2) basis of the design period, and (3) potential risk due to presence of the sabo dam. It was also suggested that a watershed management program should be integrated to the project and dams should be desilted from time to extend its useful life.

The DPWH officials responded the body by following information. Most of the eleven river basins in the country are already being studied, while the Laoag River Basin dose not have a comprehensive master plan for flood control. The design period was based on the historical flooding data and the economic viability of the project. The potential risk due to the presence of the sabo dam is quite low. The possibility of a dam failure is quite remote since possible dam failure could only occur by a debris flow in a river channel with a slope of 7 to 25%. In this project, it is very unlikely that debris flow may eventually reach the proposed dam site since the proposed sabo dams are to be located on riverbeds with slope of less than 3%. Even though in the event of a dam failure, the study showed that the river channels in the immediate downstream reach of sabo dams have enough capacity to absorb the released sediments from dam break.

A media practitioner asked about the source of funds for the project. The DPWH officials responded by informing the body that the Government of Philippines will get a foreign project loan. The another participant expressed his skepticism on the effectiveness of the proposed sabo dams in controlling the sediment deposition and believe that the proposed dam volumes are not enough. The DPWH officials responded by explaining that a comprehensive study was undertaken and the sediment dynamics was studied carefully.

The representative of DENR's Ilocos Norte PENRO Office further informed the body that DENR will carefully review the EIS of the project to assure all stakeholders that their concern will be considered.

5.5.3 Conclusion

After all the issues were resolved/discussed, the DPWH officials asked the participants if they have any fears or apprehensions regarding the various structures to be constructed under the proposed project. The people did not express any fears nor interpose any objection to the proposed structures, since the people accepted the project. The District Engineer, INED-1 requested the LGUs for their official project endorsement.

TABLES

Table F.1.1(1) Results of Vegetation Survey

Primary Impact Zone (where sabo dams will be constructed)

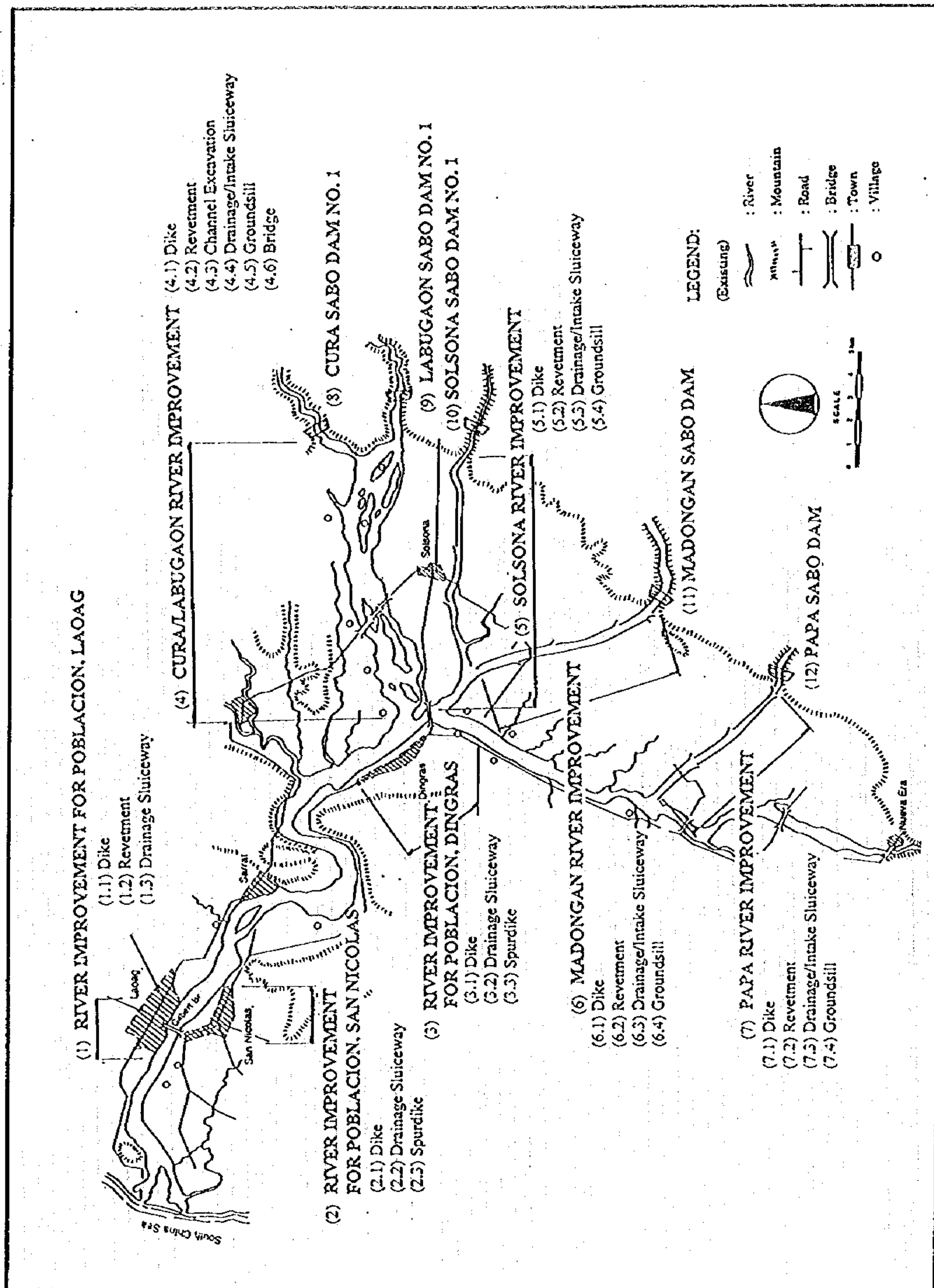
Scientific Name	Common Name	Economic Importance
A. Non-Dipterocraps		
Leucaena Leucocephala	Ipil-ipil	Wood is good for firewood and charcoal; bark produces a brown dye leaves can be used as animal feeds; seeds used as substitute for coffee
Bauhinia purpurea	Alibangbang	Leaves are edible and can be used as condiment; bark and leaves have medicinal properties; wood can be used for temporary construction, firewood and charcoal
Psidium guajava Linn (Myrtaceae)	Bayabas	Decoction of leaves is good for stomach ache and as vermifuge. Tea can be made from leaves. Fruit is used for manufacture of jellies. Wood for light construction
Eucalytus camaldulensis	Eucalytus	Source of aromatic oils for medicinal use
Acacia mangium	Yellow acacia	Wood used for light construction Young
Tamarindus indica	Sampalok	leaves, flowers and pods are used for seasoning foods; fruit used in the manufacture of jams, sweets and drinks; bark is source of ink; seed is source of oil/varnish; street ornamental plant
Gmelina arborea	Gmelina	Reforestation tree species
Acacia auriculiformis		
Musa sapientum	Banana	Fruits is used as food; the inner core, trunk and flower are used as vegetables
Colocasia esculentum	Gabi	Fruit/root is used as food
Manihot esculenta	Kamoteng kahoy	Fruit/root is edible
B. Bamboo		
Schizostachyum lumampao	Buho/Kawayan	Young shoots are edible, wood for light construction
Bambusa spenosa	Kawayan	Wood for light construction
Bambusa arundinacea	Kawayan	Young shoots are edible
Bambusa blumeana	Kawayan	Young shoots are edible
C. Grasses		
Imperata cylindrica	Kogon	Pseudostachym polymorphum
Brachiaria reptans	Marakauayan	Good fodder for stock animals

Table F.1.1(2) Results of Vegetation Survey

Vicinity of Proposed Project Site

Scientific Name	Common Name	Economic Importance
A. Non-Dipterocraps		
Mangifera indica L.	Mangga	The fruit is highly priced and edible. A decoction of the root is diuretic. Bark and seeds used as astringent. Leaves prepares as tea.
Psidium guajava Linn. (Myrtaceae)	Bayabas	Decoction of leaves is good for stomach ache and as vermifuge. Tea can be made from leaves. Fruit is used for manufacture of jellies. Wood for light construction
Averrhoa carambola	Balimbing	Fruits are edible and has medicinal value; also used as stain remover
Bougainvellia spectabilis	Boganvilla	Ornamental plant
Bixa orellana	Achuete	Seeds are used for coloring food and fabrics; can be used for landscaping
Acacia mangium	Yellow Acacia	Wood used for light construction
Maize spp.	Corn	Source of carbohydrates
Eucalyptus robusta	Eucalyptus	Wood used for house shingles, shipbuilding, general construciton
Tamarindus indica	Sampalok	Young leaves, flowers and pods are used for seasoning foods; fruit used in the manufacture of jams, sweet and drinks; bark is source of ink; seed is source of oil/varnish; street ornamental plant
Manihot esculenta	Kamoteng kahoy	Fruit/root is edible
Musa sapientum	Banana	Fruit is used as food; the inner core, trunk and flower are used as vegetables
Swietenia macrophyla	Mahogany	Wood used for construction purposes
Pterocarpus indica	Narra	Wood for carvings and decorative uses; for wood finish
Casuarina equisetifolia	Agoho	Wood used for light construction
Gliricidia sepium (Jacq.) Steud. (Leguminoseae)	Kakawate	Ornamental and very good fence material. The branches are used as firewood and the juice of the leaves is used to cure itches and wounds
Shorea guisok	Guiho	Wood used for light construction
Leucaena Leucocephala	Ipil-ipil	Wood is good for firewood and charcoal; bark produces a brown dye; leaves can be used as animal feeds; seeds used as substitute for coffee
Macaranga grandifolia	Takip asin	Wood can be used for fuel; resin is used a astringent
Colocasia esculentum	Gabi	Fruit/root is used as food
B. Bamboo		
Schizotachyum lumanpao	Kawayan/Buho	Wood used for light construction
Bambusa arundinacea	Kawayan	Young shoots are edible
Bambusa blumeana	Kawayan	Young shoots are edible
C. Grasses		
Imperata cylindrica	Kogon	Pseudostachym, polymorphum
Brachiaria reptans	Marakauayan	Good fodder for stock animals

FIGURES



THE STUDY ON SABO AND FLOOD CONTROL IN THE LAOAG RIVER BASIN	Fig. F.1.1
JAPAN INTERNATIONAL COOPERATION AGENCY	Sabo and Flood Control Project in Laoag River Basin

ATTACHMENT I

WATER QUALITY STUDY

WATER QUALITY STUDY

1 SUMMARY

Survey on the water quality characteristics of the Laoag River Basin and Daorao creek of Laoag City was conducted from 9 February to 9 March 1997. The survey was part of the environmental impact assessment study of the proposed Sabo Dams and Flood Control Project in the Laoag River Basin.

The collection of water samples and the subsequent laboratory analyses strictly adhered to the standard methods stipulated by the Department of Environment and Natural Resources (DENR). Water samples were collected from ten (10) sampling stations. The parameters analyzed are pH, water temperature, conductivity, total phosphorus, BOD, total dissolved solids, total suspended solids, nitrate, oil and grease, dissolved oxygen, salinity and total coliforms.

Almost all the parameters analyzed are within the DENR standards. The rivers of the Laoag River Basin consistently showed low values of the parameters analyzed. The results of the water characterization confirms that the water quality of these rivers are still within the values of the parameters set for Class A waters. However, Daorao creek registered relatively high values of the parameters analyzed. Compared with the rivers of the Laoag River Basin, this creek is considerably polluted.

2 GENERAL

Rivers have always been a good source of food and livelihood for the communities surrounding it and contribute to agricultural development through its use in irrigation. Water quality and quantity are related to both water and land management. Poor land and water management leads to the removal of vegetation, loss of soils through erosion, destruction of wet lands and an increase in impervious surfaces. Erosion not only destroys valuable land, it pollutes rivers, streams and lakes. Alterations of stream flow can also impair the natural method of purifying runoff. Local land use and development regulations must be adopted if a community is to maintain a stable surface and ground water supply while mitigating the damage due to flooding and ground water pollution.

This study aims to establish a baseline data/information on the water quality of the various rivers in the Laoag River Basin.

3 IDENTIFICATION OF SAMPLING STATIONS

The various rivers of the Laoag River Basin were examined for their water quality characteristics. These rivers include Laoag River, Labugaon River, Madongan River, Papa River, and Solsona River. In addition, water quality investigation of Daorao creek of Laoag City was included. All of these water bodies drain to the South China Sea.

Based on the recommendation contained in the Feasibility Study of the proposed project, ten (10) sampling stations were identified. The location of the sampling stations are shown in Fig. 1. The following table presents the location of the ten (10) sampling stations.

Attachment I

Station Number	Location
1	Laoag River Mainstream about 5 km from South China Sea, Suyo, Laoag
2	Downstream of Laoag River Gilbert's Bridge, Laoag City
3	Downstream of Laoag River about 50-100 m away from the drainage outfall of Northern Food Corporation Facility, San Joaquin, Sarrat
4	Upstream of Bongo River Kauplasan Bridge, Dingras
5	Daorao creek At bridge bordering Navotas and Cataban, Laoag City
6	At bridge, downstream of Daorao creek Pila, Laoag City
7	Upstream of Labugaon River Labugaon Diversion Dam, Maananteng, Solsona
8	Upstream of Solsona River Solsona Diversion Dam, Catanglaran, Solsona
9	Upstream of Madongan River Madongan Diversion Dam, San Marcelino, Dingras
10	Upstream of Papa River Papa Diversion Dam, Ragus, Marcos

4 SAMPLE COLLECTION AND METHODS OF ANALYSES

Water samples were collected three (3) times from each of the sampling stations in a two-week sampling interval. Collections were done on the following dates: February 9, February 23 and March 9, 1997.

During sample collection, it was always hot and sunny in the project area. There were no rain a few days before the sampling day. The collection usually starts at about 9:00 AM and lasts until 4:00 PM.

Using portable equipment, the parameters pH, temperature and conductivity were measured on site. Water samples for dissolved oxygen (DO) were fixed, preserved in an ice box and subsequently analyzed in the laboratory. All the rest of the parameters such as total phosphorus, BOD (5 days, 20°C), total dissolved solids, total suspended solids, nitrate (NO_3), oil and grease, salinity, and total coliforms were all analyzed immediately upon arrival in the laboratory.

The methods of laboratory analyses employed follow the accepted methods of analyses described in the DENR Administrative Order No. 34, otherwise known as the Revised Water Usage and Classification/Water Quality Criteria Amending Section Nos. 68 and 69, Chapter III of the 1978 NPCC Rules and Regulations. The methods used are shown in the following table.

Parameter	Method of Analysis
BOD5	Azide Modification
Dissolved Oxygen (DO)	Azide Modification (Winkler Method)
Nitrate	Brucine Method
Oil and Grease	Gravimetric Method (Petroleum Ether Extract)
pH	Glass Electrode Method
Total Suspended Solids	Gravimetric Method
Temperature	Use of Mercury-Filled Thermometer
Total Coliforms	Multiple-Tube Fermentation Technique

5 RESULTS AND DISCUSSION

The results of laboratory analyses for each sampling stations are shown in Table 1. These results are compared with the DENR Standards for Class A (Public Water Supply Class II) and Class D (Water for Irrigation), of which parameters are presented in Table 2. The rivers of the Laoag River basin fall under the Class A category. In DAO 34, Class A water is defined as sources of water supply that will require complete treatment such as coagulation, sedimentation, filtration and disinfection in order to meet the National Standard for Drinking Water (NSDW). Water from these rivers is also presently utilized as irrigation water.

(1) pH

pH is the indication of the acidity or alkalinity of the system. In water bodies, the diurnal fluctuations in pH are primarily associated with the respiratory and photosynthetic activities of the phytoplankton. pH is also influenced by the presence of organic and inorganic materials entering the water bodies. Reports averred that animal dung such as cow droppings raises the pH of water rapidly. However, its effects are temporary and more acid solution are quickly restored. In some cases, the discharge of unneutralized acid or alkaline effluents greatly alters the pH of the receiving water of the river system. In this case, the effect may be adverse.

Based on the results of the laboratory analyses, pH values fall within the expected pH range (6-9) for natural body of water. The recorded values did not exceed the DENR pH standard for Class A and Class D waters which are 6.5 - 8.5 and 6.0 - 9.0, respectively. The results suggest that at least during the survey duration, the background pH is not too low nor too high and that there is no major source of acidic or basic loadings that is capable of changing the background pH values.

With the proposed project, the background pH of the water is not expected to be changed. Only Sabo Dams and related structures will be constructed during project implementation. There will be no potential source of acidic or basic loadings from the proposed project that will alter the pH of the surrounding water of Laoag River basin.

(2) Temperature

The temperature of river waters can be influenced by the degree of insulation, substrate composition, turbidity, ground- or rainwater inflows, wind and vegetation cover. It is common that the water temperature during dry season is higher than that of during wet season. Generally, surface-water temperatures follow the ambient air temperature fairly closely. However, during dry, hot conditions, the surface water temperature is more likely to be correlated with air-temperature minima owing to the cooling effect of evaporation.

It is expected that water in the main channel of the Laoag River basin rarely stratifies. This is due

to turbulence brought about by strong mixing associated with river flow. High level of river flow is obvious based on the absence of algae growth along the main channel of the river basin.

The surface water temperature observed range from 20.5°C to a high as 32.6°C. It is generally observed that the surface temperature is lower in the morning time and higher in the afternoon.

The proposed project is not expected to greatly influence the water temperature of the main channel of the Laoag River basin. At dam site, temperature stratification also may not be possible since water level will not be deeper and its flow will be turbulent due to sediment filling up the sedimentation basin.

(3) Conductivity

Conductivity is a measure of the total amount of ions present in a body of water. The parameter is therefore useful in the approximation of the water samples chemical richness. As a measure, however, it does not give an indication of the actual ionic composition of the water, and may therefore fail to convey information on limiting factors such as lack of essential nutrients.

Based on the observed values of conductivities in this study, the values are less variable and it seems that the difference are not too big. The values range from a low as 126 to a high as 208 µmhos/cm. It is a known fact that conductivity of a given system changes throughout the year. Since the survey was conducted during dry season, it is expected that lower conductivities are to be obtained should the measurement had been done during the rainy season.

The broad, ionic composition of water is largely determined by four processes namely; (1) dilution effect whereby flood or rainwater with weak ionic concentration reduces conductivity, (2) solution effect, whereby salts locked on previously dry land by decaying organic matter enter solution as the flood water extend over large areas, (3) concentration by evaporation, and (4) absorption by living components. Normally, these effects combined tend to produce higher conductivities during the dry season than in the wet in the river channels, giving an inverse relationship between water depth and conductivities.

(4) Phosphorus

Phosphorus occurs in natural waters and in wastewaters almost solely as phosphates. The classification of phosphates are orthophosphates, condensed phosphates (pyro-, meta-, and other polyphosphates), and organically bound phosphates. The occurrence of phosphate can be in the form of solution, particles or detritus, or in the bodies of aquatic organisms. These forms of phosphate arises from a variety of sources. For instance, orthophosphates are applied to agricultural or residential cultivated lands as fertilizers and is carried into surface waters with storm runoff. When water is used for laundering or cleaning purposes, a large quantity of condensed phosphate is used. Condensed phosphate is a major constituent of many commercial cleaning preparations. Organophosphates, on the other hand, is a major constituent of agro-chemicals such as pesticides and insecticides.

Phosphorus is essential to the growth of organisms and can be a nutrient that limits the primary productivity of a body of water. In instances where phosphate is a growth-limiting nutrient, the discharge of raw or treated wastewater, agricultural drainage, or certain industrial wastes to that water may stimulate the growth of photosynthetic aquatic micro- and macro-organisms in nuisance quantities. This excessive growth of organisms may lead to a phenomenon called eutrophication.

Based on the results of the phosphorus analysis of water samples taken from 10 sampling stations, the levels of phosphorus concentrations are relatively low. In most of the cases, the level of concentrations registered are within the DENR standard.

Water samples from Daorao creek registered the highest phosphorus concentration level. It registered a concentration range of about 0.15-0.49 mg/L. Daorao creek received domestic and commercial wastewaters from the city proper. As presented earlier, domestic wastewaters may be rich in phosphorus originating from the use of phosphorus-containing detergents by the local

people. Most of the locally available cleaning detergents are still phosphorus-base reagents.

Another possible reason why Daorao creek has the highest phosphorus content is the leaching of organophosphates from agro-chemicals and fertilizers used by the farmers. Ocular inspection showed that farming is still being practice along Daorao creek. It is possible that its phosphorus content may come from the runoffs of these farms which are using inorganic fertilizers and organophosphates pesticides and insecticides.

Within the Laoag River basin, agricultural practice is also rampant. Phosphorus-rich runoff may also enter the river basin. But since the river flow is big enough, flashing and dilution effect may offset the concentration levels of phosphorus in the river. These confirm the results of phosphorus analysis of water samples taken from the various rivers of the Laoag River basin. The samples from these rivers registered very low level of phosphorus concentration. Comparing these river with Daorao creek, the latter has relatively low water flow.

The proposed project is expected not to exert impact on the phosphorus content of the river water. However, since the secondary use of the project is for irrigation purposes, farming practices along the river basin may become more extensive. These may result to the use of more agro-chemicals by the farmers which may finally enrich the agricultural water runoff with phosphorus. These water runoff will contribute to the non-point source of phosphorus contamination of the river.

(5) Biochemical Oxygen Demand (BOD)

The method of biochemical oxygen demand (BOD) determination consists of placing a sample in a full airtight bottle and incubating the bottle at 20°C within 5 days. Dissolved oxygen (DO) is measured initially and after incubation. The BOD is computed from the difference between initial and final DO.

The BOD determination is an empirical test which determine the relative oxygen requirements of water samples. The test measures the oxygen required for the biochemical degradation of organic or carbonaceous materials present in the water samples. In other words, the higher the organic contamination of the sample, the higher will be its BOD value.

Based on the results of the analysis, BOD values for all the samples taken are low. The values registered are all within the DENR standard for BOD. The pristine river of Madongan, Papa, Labugaon and Solsona showed consistently low BOD levels. Samples from Daorao creek registered the highest value of about 3.6 mg/L. Daorao creek receives domestic and commercial wastewater from Laoag City.

(6) Total Suspended and Total Dissolved Solids

The term solids in these water parameters refer to matter suspended or dissolved in water. These solids may affect the water quality in many ways. For instance, water with high dissolved solids generally are of inferior palatability and may induce an unfavorable physiological reaction in the water users. Highly mineralized waters also are unsuitable for many industrial applications. Waters high in suspended solids may be aesthetically unsatisfactory for such purposes as bathing.

From environmental point of view, solids analyses are important in the control of biological and physical wastewater treatment processes and for assessing compliance with the required effluent standards. From engineering point of view such as in dam projects, solids is important in determining the effective life span of dam projects with respect to its water holding capacity. It is also important in determining the rate of siltation of the dam projects.

Compared with the DENR Standard for Class A and Class D waters, the parameters total suspended solids and total dissolved solids showed relatively low values for all the samples taken for analyses. The rivers of Madongan, Papa, Labugaon and Solsona consistently showed very low concentrations of both total suspended and dissolved solids.

Samples from Daorao creek again registered the highest level of concentrations of total

suspended and dissolved solids. It may be possible that the wastewater draining to Daorao creek has high solids content. Another possible explanation is that agricultural runoff from the nearby farmlands are rich with both suspended and dissolved solids.

It should be noted that the water quality survey was conducted during the dry season. During. which time, there was no record of rains and other climatic disturbance in the area. The results of the solids analyses only show that there is no sediment runoff from the mountains or upstream of the river basin at this time. However, the quality of water samples especially its solids content may have been higher when the survey had been conducted during the rainy season.

(7) Nitrate

In waters the forms of nitrogen of greatest interest are nitrate, nitrite, ammonia and organic nitrogen. They are biochemically interconvertible and are part of the nitrogen cycle.

The total oxidized nitrogen is the sum of nitrate and nitrite nitrogen. Nitrate generally occurs in trace quantities in surface water but may attain high levels in some groundwater. Nitrate is of interest for the reason that when present in excessive amount, it contributes to the illness known as methemoglobinemia or blue baby in infants. This is the reason why a limit of 10 mg nitrate as nitrogen per liter has been imposed on drinking water to prevent this disorder.

Nitrate is found only in small amounts in fresh domestic wastewater. However, a higher concentration level at a high as 30 mg nitrate as nitrogen per liter can be found in the effluents of biological treatment plants. Like phosphorus, nitrate is an essential nutrient for many photosynthetic organisms. In some case, nitrate has been identified as the growth-limiting nutrients.

Results of nitrate analyses suggest that there is no alarming cases of nitrogen pollution in any of the sampling locations. The nitrate concentrations are all within the DENR standards. During sampling, it was observed that in almost all the sampling sites, there were patches of animal manures within the vicinity of the sampling location. It is often reported that animal manures are good source of nitrate. In this case, however, it could be deduced that these manures do not significantly contribute to the level of nitrate content of the river waters. It could be that the high flows of the rivers exert flushing and dilution effect.

Daorao creek registered the highest level of nitrate concentration. Possible sources of these nitrates may come from the domestic wastewater being discharge from Laoag City and fertilizer runoff from nearby agricultural farmlands.

(8) Oil and Grease

Oil and grease are groups of substances with similar physical characteristics. They are determined quantitatively on the basis of their common solubility in petroleum ether. Oil and grease, therefore, refers to the material recovered as a substance soluble in petroleum ether.

From environmental point of view, grease and oil when discharge in excessive amount may cause surface films and shoreline deposits leading to environmental degradation. Therefore, a knowledge of the oil and grease content of river is helpful in proper river management by regulating the discharge of wastewater effluents containing high concentration of oil and grease.

Based on the result of the survey, oil and grease content of all the water samples are within the standard set by DENR. Samples from the Laoag River Basin consistently showed very low to non-detectable oil and grease concentration. A relatively high concentration was observed in samples taken from Daorao creek. It should be pointed out that water runoff from roads and other sources such as gasoline stations which drain to the creek may contribute to the observed values of oil and grease in Daorao creek samples. This is coupled by the contribution of domestic wastewater which is also received by Daorao creek.

(9) Dissolved Oxygen

Dissolved oxygen (DO) levels in natural waters depends on the physical, chemical and

biochemical activities in the water body. The analysis for dissolved oxygen is a key test in water pollution and waste treatment process control. High values of DO indicate that there is no alarming case of organic pollution.

Based on the results of the water quality survey, the values for dissolved oxygen are high in all samples from the rivers except for samples collected from Daorao creek. Since this creek is constantly receiving wastewater from the city proper, the DO level is expected to be low. Some of the observed values are below the DENR standards of 5 mg/L.

(10) Total Coliform

The conduct of the total coliform tests provide indication on the extent of coliform contamination of the water samples. The bacterial concentration is usually expressed in Most Probable Number (MPN). The result of the total coliform analysis made no distinction between pathogenic (usually called fecal coliform) and non-pathogenic coliforms. Since the tributaries of the Laoag River basin is classified as Class A river, when use as water supply source, it requires complete treatment including disinfection. Therefore, users should be cautious of not using the river as their source of drinking water to avoid incidence of water borne diseases.

Based on the results of the survey, the levels of total coliforms are consistently high in all the samples taken for analyses. During sample collection, it was observed that there were some farm animals like cows roaming around the vicinity of the rivers. It may be possible that farm animals discharging manure contribute on these observed data.

In order to confirm the accuracy of laboratory test results, water sampling was conducted again on June 30, 1997. The results are enumerated in Table 3. According to laboratory test done by DOH Regional Office, water quality in entire sampling sites are within the values of total coliforms set for Class A waters.

(11) Salinity

Salinity is defined as the total solids in water after all carbonates have been converted to oxides, all bromide and iodide have been replaced by chloride, and all organic matter has been oxidized. It is usually numerically smaller than the total dissolved solids and is reported as grams per kilogram.

Salinity is an important measurement in the analysis of certain water samples such as seawater or water suspected to be contaminated or intruded with seawater. In this study, a sampling station (Station No.1) which is some 5 kilometers away from the sea was tested for salinity. The concentration range (0.06 - 0.09 g/kg) for Station No.1 indicates that the downstream reaches of Laoag River are still not influenced by seawater.

Samples from Daorao creek were likewise subjected to the same test. Results showed a concentration range of 0.07 to 0.12 g/kg which indicates that salinity due to the enrichment of salts from fertilizers is not yet critical at this creek.

Attachment I

Table 1(1) Water Quality Test Results

Station No.1, Laoag River, about 5 km from South China Sea, Suyo, Laoag City

Parameter	Date of Sample Collection		
	February 9, 1997	February 23, 1997	March 9, 1997
pH	8.31	8.29	8.70
Water Temperature, °C	31.4	26.7	30
Conductivity,	127.3	114.4	144.3
Total Phosphorus, mg/L	0.04	0.07	0.10
BOD (5 days, 20°C), mg/L	1.0	1.5	1.1
Total Dissolved Solids, mg/L	152	158	151
Total Suspended Solids, mg/L	4.6	16	6.0
Salinity, g/Kg	0.09	0.08	0.06
Nitrate (NO_3), mg/L	0.10	ND	1.4
Oil and Grease, mg/Lq	4.7	5.0	0.62
Dissolved Oxygen, mg/L	11.8	12.6	3.2
Coliforms, MPN/100mL	5,000	160,000	>160,000
Time of Sample Collection	2:30 PM	3:45PM	3:40PM
Weather	sunny	sunny	sunny
Notes: ND is none detected; Minimum Detection Limits: TSS, mg/L = 1.0; NO_3, mg/L= 0.01; Oil & grease, mg/L = 0.5			

Station No.2, Downstream of Laoag River, Gilbert Bridge, Laoag City

Parameter	February 9, 1997	February 23, 1997	March 9, 1997
pH	8.5	8.25	8.31
Water Temperature, °C	32.6	24.4	31.1
Conductivity,	126.2	148.1	179.4
Total Phosphorus, mg/L	0.08	0.05	0.08
BOD (5 days, 20°C), mg/L	1.3	1.8	1.0
Total Dissolved Solids, mg/L	153	152	155
Total Suspended Solids, mg/L	6.8	3.2	4.4
Nitrate (NO_3), mg/L	1.0	0.50	ND
Oil and Grease, mg/Lq	3.3	1.5	1.3
Dissolved Oxygen, mg/L	9.8	10.6	11.4
Coliforms, MPN/100mL	5,000	>160,000	>160,000
Time of Sample Collection	2:05 PM	3:20 PM	3:20
Weather	sunny	sunny	sunny

Station No.3, Downstream of Laoag River at about 100 m away from drainage outfall of Northern Food Corporation Facility, San Mateo, Sarrat

Parameter	February 9, 1997	February 23, 1997	March 9, 1997
pH	8.9	8.22	8.24
Water Temperature, °C	27.4	22.7	26.7
Conductivity	204	195.6	184.6
Total Phosphorus, mg/L	0.04	0.03	0.16
BOD (5 days, 20°C), mg/L	1.17	1.4	1.0
Total Dissolved Solids, mg/L	142	140	142
Total Suspended Solids, mg/L	2.6	ND	1.6
Nitrate (NO_3), mg/L	1.8	0.90	ND
Oil and Grease, mg/Lq	1.1	ND	1.2
Dissolved Oxygen, mg/L	9.8	11.5	10.1
Coliforms, MPN/100mL	9,000	90,000	>160,000
Time of Sample Collection	8:45 AM	9:25 AM	8:24
Weather	sunny	sunny	sunny

Table 1(2) Water Quality Test Results

Station No.4, Upstream of Bongo River , Kauplasan Bridge, Dingras

Parameter	Date of Sample Collection		
	February 9, 1997	February 23, 1997	March 9, 1997
pH	8.9	8.46	8.30
Water Temperature, °C	31.8	28.2	30.8
Conductivity,	133	130.9	147.4
Total Phosphorus, mg/L	0.02	0.02	0.07
BOD (5 days, 20°C), mg/L	1.6	1.5	1.0
Total Dissolved Solids, mg/L	176	151	150
Total Suspended Solids, mg/L	5.6	ND	1.0
Nitrate (NO_3), mg/L	ND	ND	ND
Oil and Grease, mg/Lq	1.8	ND	ND
Dissolved Oxygen, mg/L	10.8	11.6	11.1
Coliforms, MPN/100mL	2,300	>160,000	90,000
Time of Sample Collection	1:00 PM	2:00 PM	2:00PM
Weather	sunny	sunny	sunny
Notes: ND is none detected; Minimum Detection Limits: TSS, mg/L = 1.0; NO_3, mg/L= 0.01; Oil & grease, mg/L = 0.5			

Station No.5, Daorao Creek at bridge bordering Navotas and Cataban, Laoag City

Parameter	February 9, 1997	February 23, 1997	March 9, 1997
pH	7.39	7.46	7.30
Water Temperature, °C	28.2	25.9	26.5
Conductivity,	150.2	169.5	163.3
Total Phosphorus, mg/L	0.15	0.13	0.43
BOD (5 days, 20°C), mg/L	0.9	1.0	1.0
Total Dissolved Solids, mg/L	263	292	287
Total Suspended Solids, mg/L	23	12.2	9.2
Salinity, g/Kg	0.10	0.09	0.07
Nitrate (NO_3), mg/L	4.0	0.30	ND
Oil and Grease, mg/Lq	3.2	2.8	1.0
Dissolved Oxygen, mg/L	4.9	4.5	13.4
Coliforms, MPN/100mL	5,000	160,000	>160,000
Time of Sample Collection	2:50 PM	4:17 PM	4:00
Weather	sunny	sunny	sunny

Station No.6, Downstream of Daorao Creek, Pila, Laoag City

Parameter	February 9, 1997	February 23, 1997	March 9, 1997
pH	7.58	7.4	7.47
Water Temperature, °C	28.0	25.4	26.4
Conductivity,	170	146.9	170.3
Total Phosphorus, mg/L	0.15	0.35	0.49
BOD (5 days, 20°C), mg/L	1.85	3.6	2.7
Total Dissolved Solids, mg/L	276	322	279
Total Suspended Solids, mg/L	69.2	32.	45.6
Salinity	0.10	0.12	0.08
Nitrate (NO_3), mg/L	ND	0.30	1.3
Oil and Grease, mg/Lq	3.7	5.0	ND
Dissolved Oxygen, mg/L	4.1	3.5	5.0
Coliforms, MPN/100mL	90,000	>160,000	160,000
Time of Sample Collection	3:25 PM	4:30 PM	4:20PM
Weather	sunny	sunny	sunny

Attachment I

Table 1(3) Water Quality Test Results

Station No.7, Upstream of Labugaon River, Diverson Dam, Maananteng, Solsona

Parameter	Date of Sample Collection		
	February 9, 1997	February 23, 1997	March 9, 1997
pH	8.21	8.24	8.31
Water Temperature, °C	24.4	21.5	22.7
Conductivity,	160	208.2	174.4
Total Phosphorus, mg/L	0.02	0.02	0.02
BOD (5 days, 20°C), mg/L	1.2	1.6	1.0
Total Dissolved Solids, mg/L	94.1	84.6	91.6
Total Suspended Solids, mg/L	ND	ND	ND
Nitrate (NO_3), mg/L	0.30	ND	ND
Oil and Grease, mg/Lq	1.0	0.80	0.52
Dissolved Oxygen, mg/L	11.4	12.4	9.0
Coliforms, MPN/100mL	200	30,000	1,300
Time of Sample Collection	9:55 AM	10:46 AM	10:45AM
Weather	sunny	sunny	sunny
Notes: ND is none detected; Minimum Detection Limits: TSS, mg/L = 1.0; NO_3, mg/L= 0.01; Oil & grease, mg/L = 0.5			

Station No.8, Upstream of Solsona River, Diversion Dam, Catanglaran, Solsona

Parameter	February 9, 1997	February 23, 1997	March 9, 1997
pH	8.26	8.29	8.55
Water Temperature, °C	24.5	20.5	22.8
Conductivity,	140	156	161.5
Total Phosphorus, mg/L	0.02	0.02	0.02
BOD (5 days, 20°C), mg/L	0.90	1.3	1.1
Total Dissolved Solids, mg/L	105	86.1	93.0
Total Suspended Solids, mg/L	ND	ND	ND
Nitrate (NO_3), mg/L	ND	0.2	ND
Oil and Grease, mg/Lq	1.2	ND	1.1
Dissolved Oxygen, mg/L	10.9	12.6	10.1
Coliforms, MPN/100mL	800	24,000	1,700
Time of Sample Collection	10:30 AM	11:00 AM	11:10AM
Weather	sunny	sunny	sunny

Station No.9, Upstream Madongan River, Diversion Dam, San Marcelino, Dingras

Parameter	February 9, 1997	February 23, 1997	March 9, 1997
pH	7.82	7.85	7.95
Water Temperature, °C	26.1	25.2	26.3
Conductivity,	160.7	179.9	169.9
Total Phosphorus, mg/L	0.02	0.02	0.03
BOD (5 days, 20°C), mg/L	0.9	1.2	1.0
Total Dissolved Solids, mg/L	114	111	113
Total Suspended Solids, mg/L	ND	ND	ND
Nitrate (NO_3), mg/L	ND	ND	0.70
Oil and Grease, mg/Lq	1.0	ND	1.7
Dissolved Oxygen, mg/L	11.5	10.5	9.3
Coliforms, MPN/100mL	<200	24,000	2,300
Time of Sample Collection	10:20 AM	12:32 AM	12:30PM
Weather	sunny	sunny	sunny

Table 1(4) Water Quality Test Results
Station No.10, Upstream of Papa River, Papa Diversion Dam, Ragus, Marcos

Parameter	Date of Sample Collection		
	February 9, 1997	February 23, 1997	March 9, 1997
pH	8.30	8.43	8.53
Water Temperature, °C	28.5	28.4	8.3
Conductivity,	164	135.7	131.3
Total Phosphorus, mg/L	0.04	0.02	0.13
BOD (5 days, 20°C), mg/L	0.8	1.6	1.0
Total Dissolved Solids, mg/L	152	157	154
Total Suspended Solids, mg/L	1.4	2.4	2.8
Nitrate (NO_3), mg/L	ND	ND	0.20
Oil and Grease, mg/Lq	2.1	2.8	1.1
Dissolved Oxygen, mg/L	10	13.8	10.4
Coliforms, MPN/100mL	3,000	160,000	1,300
Time of Sample Collection	12:05 AM	1:14 PM	1:09PM
Weather	sunny	sunny	sunny

Notes: ND is none detected; Minimum Detection Limits: TSS, mg/L = 1.0; NO_3, mg/L= 0.01; Oil & grease, mg/L = 0.5

Table 2 Water Quality Criteria for Conventional and Other Pollutants Contributing to Aesthetics And Oxygen Demand for Class A and Class D Waters

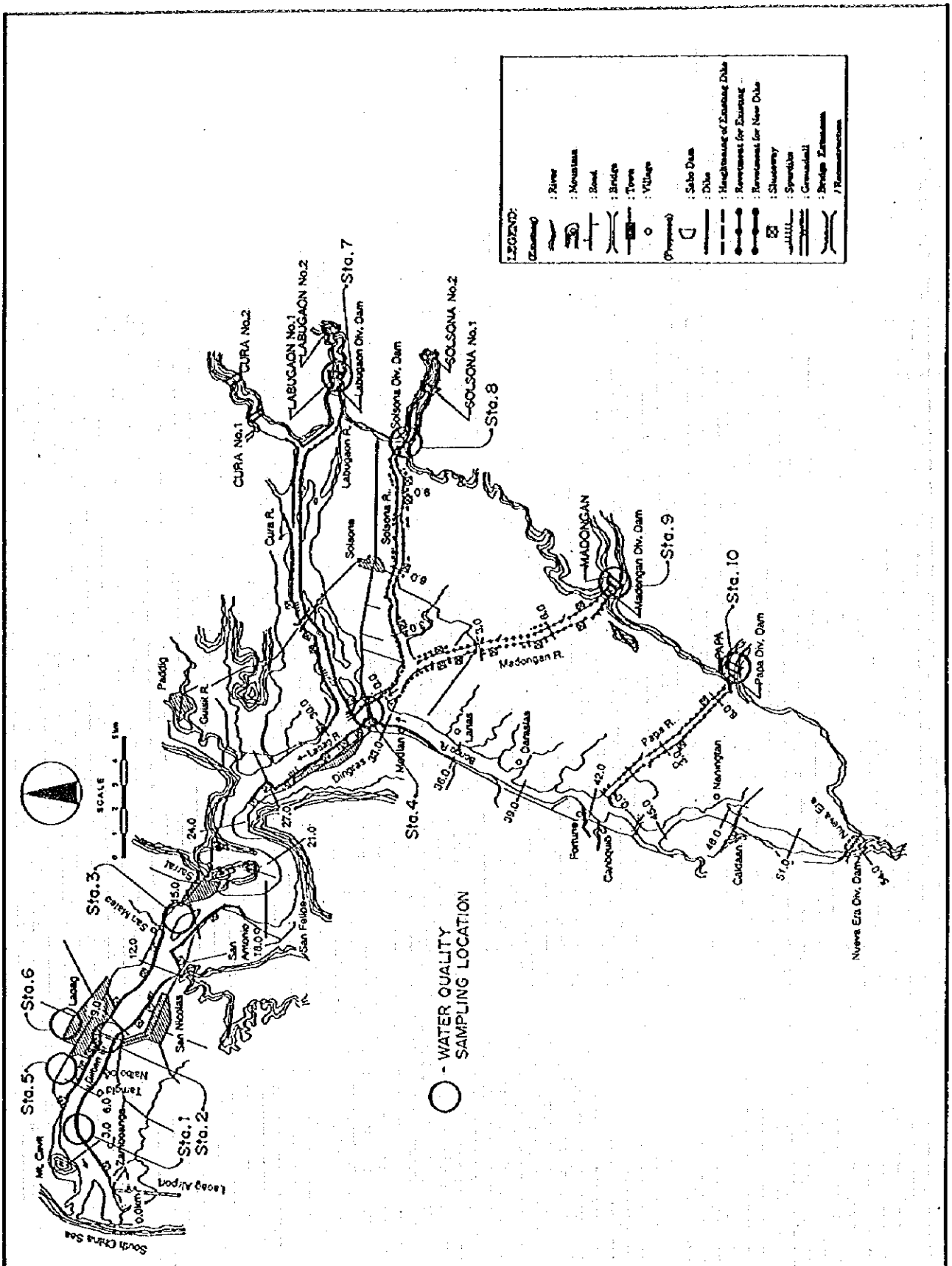
Parameter	Unit	Class A	Class D
pH (range)		6.5-8.5	6.0-9.0
Dissolved Oxygen (Minimum)	mg/L	5	3
5-Day 20°C BOD	mg/L	5	15
Total Suspended Solids	mg/L	50	(a)
Total Dissolved Solids	mg/L	1,000	1000
Oil and Grease (Petroleum Ether Extract)	mg/L	1	5
Nitrate (as N)	mg/L	10	(b)
Phosphate as Phosphorus	mg/L	0.1	(b)
Total Coliform	MPN/100mL	1,000(c)	--

(a) = Not more than 60 mg/L increase
(b) = Extremely low concentration and not detectable by existing equipment
(c) = These values refer to the geometric mean of the most probable number of coliform organism during a 3-month period and that the limit indicated shall not be exceeded in 20 percent of the samples taken during the same period

Table 3 Laboratory Test Results (Total Coliforms)

Station	Total Coliforms (MPN/100mL)
Station 1, Laoag River, Suyo, Laoag City	320
Station 2, Laoag River, Gilbert Br., Laoag City	450
Station 3, Laoag River, San Mateo, Sarrat	255
Station 4, Laoag River, Kauplasan Br., Dingras	325
Station 5, Daorao Creek, Navotas, Laoag City	280
Station 6, Daorao Creek, Pila, Laoag City	240
Station 7, Labugaon River, Diversion Dam, Solsona	345
Station 8, Solsona River, Diversion Dam, Solsona	605
Station 9, Madongan River, Diversion Dam, Dingras	265
Station 10, Papa River, Diversion Dam, Marcos	585

Sampling Date: June 30, 1997



THE STUDY ON SABO AND FLOOD CONTROL IN THE LAOAG RIVER BASIN	Fig. 1
JAPAN INTERNATIONAL COOPERATION AGENCY	Location of Water Sampling

ATTACHMENT II

SOCIO-ECONOMIC ASPECTS

SOCIO-ECONOMIC ASPECTS

1 Methodology

To gather the data required, the study uses three techniques. First is the conduct of a sample survey using a household questionnaire. The survey covered 79 households in the six barangays in the direct impact area. The barangays are as follows: Lumbad and Sagpatan in the municipality of Dingras and Bagbag, Bubuos, Nalasin and Lipay in the municipality of Solsona. These barangays are chosen being located in a high intensity flooding area. Their total number of households is 772. The sample size is computed to have a desired reliability of 95% and a maximum sampling error of 10 percent. The second technique is the interview of key informants. These are persons considered knowledgeable on the social services and environmental problems in the barangay. The concerned government personnel and barangay officials will serve as key informants. The third technique is the collection of secondary data from the National Statistics Office, health centers and municipal hall of the municipality where the project is located.

2 Socio-Economic Setting

2.1 Demography

2.1.1 Population Size and Growth

One city and eight municipalities in Ilocos Norte serve as the direct impact area of the project. The city is Laoag while the municipalities are as follows: Carasi, Dingras, Marcos, Nueva Era, San Nicolas, Sarrat, Solsona and Piddig. The direct impact area has close to half (47%) of the population of the whole province. This is the size of the population exposed to the yearly flood in the Laoag River Basin. The direct impact area has a combined population of 218,000 in 1990 and 228,323 in 1995. Within the five-year period, the direct impact area sustained a growth rate of 0.9 % per year. This is the same as the growth rate of the whole province. The growth rate in the direct impact area and the province is very low compared to the national population growth rate during the same period which is 2.3 percent.

Item	Direct Impact Area	Ilocos Norte
1990 population	218,000	461,661
1995 population	228,323	482,651
Annual growth rate (in percent)	0.9	0.9
Persons living in the same residence in the past five years (in percent)	95	96
Total land area (in sq km)	1,526.5	3,399.0
No. of persons per sq km.	150	142
Average members per households	4.8	4.8
Dependents per 100 persons (in percent)	73	73
Persons over 6 years old without any education (in percent)	5	5
Average number of years spent in school	8	6

Source: National Statistics Office

About 95% of the population in the direct impact area have been living in the same municipality (or city in the case of Laoag) in at least the past five years. This indicates that in-migration into the area is very low. Within that period the number of persons who moved into the municipalities where they are living now or the in-migrants compose only 5 % of the population. The percentage of in-migrants for the whole province of Ilocos Norte is slightly lower at 4 percent. At the national level, it is 5 percent. The natural increase and in-migration rate in the direct impact area and the province is close to the national level. This is the explanation of that the lower growth rate in the direct impact area and the province which is compared to the national rate is due to high out-migration.

2.1.2 Population Density

With a total land area of 1,526.5 km^2, the direct impact area has an average population density of 150 persons per km^2. The flood control project is going to benefit the more densely populated area of the province. Ilocos Norte which has 142 persons per km^2 or lower than in direct impact area. Nonetheless, the direct impact area and the province has still higher density than the national level which registers at only 230 persons per km^2.

2.1.3 Household Size, Dependency Ratio and Educational Attainment

The population of the direct impact area is distributed among 47,716 households resulting to an average of 4.8 members per household. This household size is the same as the provincial average. The household size in the direct impact area and the province reflects the dominance of children in the population. Households usually have two adults and two or three children. In the direct impact area, 35% of its population are aged below 15 years. Those aged over 64 years compose 7 %. Both age groups are considered dependents of the economically active population whose ages range from 15 to 64 years. The economically active persons constitute 58% of the population. Thus, every 100 economically active persons in the beneficiary area has 58 dependents. The dependency burden at the provincial level is the same.

Among persons aged seven years and over in the direct impact area, 5% are without any education. The same percentage prevails at the provincial level. But the average educational attainment in the direct impact area is Second Year High School having spent eight years in school. The population of the province has lower average educational attainment having reached only Grade 6 having spent six years in school.

2.2 Housing Characteristic

2.2.1 House and Homelot Ownership

About 92% of the households in the direct impact area own their houses as shown in the following table. This ownership rate is higher than the rate for Ilocos Norte where the homeowners constitute only 88 percent. However, the ownership of the homelot is much lower in the direct impact area and the province. Only 74% of the households in the direct impact area own the lot where their houses stand. The homelot ownership rate is slightly lower in the province at 73%. The non-ownership of land is relatively high and reflects the fact that it is not easily affordable.

But there are few renters. Around 25% of the households in the direct impact area are occupying their homelot for free. At the provincial level, the percentage is 23%. The renters constitute only 1% in the direct impact area and 4 % at the provincial level.

2.2.2 Housing Structure and Materials

The types of housing structures further indicates the level of housing affordability. The households who live in a single house constitute 98% in the direct impact area. In the provincial level, they constitute 99 percent or about the same as the direct impact area.

Item	Direct Impact Area	Ilocos Norte
Percentage of homeowners	92	88
Percentage of homelot owners	74	73
Percentage of houses by type of structure		
Single house	98	99
Multi-unit structure	2	1
Total	100	100
Percentage of houses by type of roof		
Galvanized iron / aluminum	82	76
Cogon / nipa / anahaw	15	21
Others (tile, wood etc.)	3	3
Total	100	100
Percentage of houses by type of wall		
Concrete/brick/stone	29	27
Concrete and wood	36	31
Wood	7	10
Bamboo/cogon/nipa	26	30
Others	2	2
Total	100	100

Source: National Statistics Office

The housing materials used indicate the economic status of the population. The use of concrete and other permanent materials for housing is taken as an indicator of higher economic status. The material most widely used for roofing in the direct impact area is galvanized iron (GI) sheet being used by 82%. Only 76% use similar material in the provincial level. Less widely used in the direct impact area are cogon or nipa. The houses roofed with these materials constitute 15%. But 21% of the houses in the province have cogon or nipa. This indicates that the households in the direct impact area may be slightly better off economically compared to the households in the province in general.

For walling, concrete combined with wood is the most widely used materials in the direct impact area as well as in the province. But there are more users of the materials in the direct impact area (36%) than in the province (31%). The same with pure concrete which is used by 29% of the households in the direct impact area. Only 27% of the households use the same material at the provincial level. Because concrete is more expensive than the other walling materials, the higher economic status of the households in the direct impact area is again indicated.

2.3 Housing Utilities

2.3.1 Toilet and Water Facilities

The ownership of toilet facilities is high in both the direct impact area and the province at 99% which is shown in the following table. The most widely used toilet facility in the direct impact area and the province is the water seated type. This is used by 92% of the households in the direct impact area and by 88% in the provincial level. The higher percentage of households in

the direct impact area using water-sealed toilets may be again taken as an indication of the better economic status of its households. The other types of toilet facilities that are used by a lesser number of households in the direct impact area and the province are the closed and the open pit types.

Item	Direct Impact Area	Ilocos Norte
Percentage of households by type of toilets used		
None	1	1
Water sealed	92	88
Closed Pit	3	5
Open pit	3	3
Others	1	1
Total	100	100
Percentage of households by source of drinking water		
Faucet	27	27
Deep well	32	31
Shallow well	9	8
Dug well	29	31
Others	3	3
Total	100	100
Percentage of households by type of cooking fuel		
Liquefied Petroleum Gas	28	22
Wood / charcoal	67	74
Others	5	5
Total	100	100
Percentage of households who uses electricity for lighting	86	80

Source: National Statistics Office

For drinking water, the higher percentage of households rely on either deep well or a dug well. The users of the deep well constitute 32% in the direct impact area and 31% in the province. Dug well which is not considered a safe source is used by 29% in the direct impact area and 31% in the province. The users of a faucet in the direct impact area and in the province comprise 27%, respectively. Water sources used by smaller portions of households are shallow well and open water bodies.

2.3.2 Cooking Fuel and Lighting

The most widely used fuel for cooking in the direct impact area and the province is still wood or charcoal. But there are less users of wood or charcoal in the direct impact area (67%) than in the province (74%). More households in the direct impact area cook with liquefied petroleum gas (LPG). They constitute 28% in the direct impact area but only 22% in the province. This may be again taken as an indicator of the better economic position of the households in the direct impact area. There is also higher proportion of households served by electricity in the direct impact area. Around 86% of the households use it for lighting. Only 80 percent of the households in the province enjoy similar facility.

2.4 Social Services

Education status in the direct impact area and in the province are shown in the following table. Education is mainly provided by the government. The direct impact area has 178 public

elementary schools or 51% of the total number of public elementary schools in the province. It has 16 of the 33 public secondary schools and one of the 5 public tertiary schools in the province.

Health care is similarly mainly provided by the government. The direct impact area has 6 of the 9 hospitals in the province. It also has 54 of the 100 barangay health stations in the province and 13 of the 26 rural health units.

The municipalities in the direct impact area are interconnected by a network of national, provincial and municipal roads. The province has 3,338 km of roads. 10% of which are concreted and 5% are paved with asphalt. The remaining 85% are paved either with gravel or earth.

Social Services	Direct Impact Area	Percentage of the Provincial Total	Ilocos Norte
Educational Services			
Public Elementary Schools	178	51	349
Public Secondary Schools	16	48	33
Public Tertiary School	1	25	5
Health Services			
Public Hospitals	6	67	9
Barangay Health Stations	54	54	100
Rural Health Units	13	50	26

Source: Department of Education and Culture and Department of Health

2.5 Employment and Income

The employment and income in the direct impact area are characterized from the result of the sample survey conducted in six barangays located in an area with high flooding intensity. These barangays are Bagbag, Bubuos, Nalasin and Lipay in Solsona and Sagpatan and Lumbad in Dingras. Among the population in the six barangays whose ages are 15 years old and over, 46% are gainfully employed and 54% are non-gainfully employed (housekeepers, students and pensioners) as shown in the following table. Gainful employment is heaviest in farming accommodating 24% of the total employed workforce. The predominance of this sector is the same throughout the province where it has 26% of the employed labor force. Such predominance reflects the heavy rural orientation of the economy in the direct impact area and in the province. This means that employment characteristics are not highly diversified that dependence on one sector prevails.

The far second concentration in the six barangays is in officials, executives and proprietors sector as well as in professional sector, each having only 5% of the total employed workforce. The professionals mostly include school teachers and midwives. A considerable proportion of 4% are in craft and related work. These include carpenters, sewers, handicraft makers and mechanics. There are few employed in elementary occupations. This sector has 3% of the labor force and include market stall vendors, street services providers, domestic helpers and farm laborers. Elementary occupations are the second biggest employers in the province of Ilocos Norte with 7% of the total employed labor force.

Item	Surveyed Households	Ilocos Norte
Persons aged 15 years old and over by occupation		
Gainful occupations (in percent)		
Officials, executives and managers	5	2
Professionals	5	2
Technicians and related professionals	1	1
Clerks	1	1
Service and market sales workers	4	2
Farmers, forestry workers and fishermen	24	26
Craft and related workers	1	4
Plant and machine operators and assemblers	2	3
Elementary occupations	3	7
Non-gainful occupations		
Students	23	15
Housekeepers	25	33
Pensioners	6	4
Total	100 %	100 %
Percentage of unemployed persons	8 %	9 %
Average household income per month	P 6,544	P 5,160

Source: February 1997 Survey and National Statistics Office

Unemployment in the direct impact area stands at 8% or about the same as the unemployment rate in province in 1990 (9%). The national unemployment rate is at 8 percent.

The average household in the six barangays earns about P6,544 per month. This is more than the 1994 average income of the households of the province which is P5,160 per month. In the six barangays, most households have two sources of income. Their main sources are farming and salaries and wages. Farming contributes 37% of the total income while salaries and wages contribute 34 percent. The rest are earned from the following: livestock sale (8%), pension (7%), business enterprises (6%), farm share (3%), remittances (2%), fishing (2%), and rented out properties (1%).

Apart from being the main contributor of household income, farming is the main employer in the six barangays. Around 95% of the households derive income from farming. Livestock raising ranks second being the source of income of 71% of the households. The households who earn salaries and wages constitute only 37 percent. Although fishing has small contribution to household income being a subsistence activity, 35% of the households in the six barangays earn from it. The percentage of households who earns from other income sources are as follows: business enterprises (18%); share from farmlands (22%); pension and allowances (18%); remittances from relatives (32%); and property rentals (2%).

2.6 Farming and Fishing

As seen in the employment characteristics and income composition, the economy in the direct impact area is largely supported by farming. The farming households in the direct impact area cultivate two or three crops. The most widely cultivated are rice and corn. Tobacco, garlic, mongo beans and an assortment of vegetables are also raised.

The direct impact area harvested 31,300 has of rice in 1995. This represents 65% of the total rice harvested area in the province. Rice are usually harvested twice a year. The average yield in the direct impact area is 3.8 MT per hectare which is higher than the average yield of 2.6 MT per hectare in the province. This points out that the direct impact area are the most productive rice land in the province.

Corn is cultivated in a much smaller scale in the direct impact area. It is usually planted in the rice land area during dry season. Corn was planted 2,900 ha and yielded 8,700 MT in the direct impact area in 1995. This size represents 49% of corn planted area and 43% of total corn production in the province. This further bolster the position of the direct impact area as the granary of the province.

Crops like corn, garlic and tobacco are planted usually as a dry season crop in the direct impact area. About 1,400 ha of garlic and 1,000 ha of tobacco are planted in 1995. The area planted compose 35% of the total garlic farming and 32% of the total tobacco farming in the province. These productions sheared 44% and 33% of the provincial production respectively. These high production share in the province is relative to the high productivity of land in the direct impact area.

Item	Harvested Area (000ha)		Yield (MT/ha)		Production (000MT)	
	Impact Area	Ilocos Norte	Impact Area	Ilocos Norte	Impact Area	Ilocos Norte
Rice	31.3	48.3	3.8	2.6	124.1	130.0
Corn	2.9	5,.9	3.3	3.4	8.7	20.3
Garlic	1.4	4.0	3.0	2.4	4.3	9.7
Tobacco	1.0	3.1	1.1	1.2	1.2	3.6

Source: Provincial Agriculture Office and Bureau of Agricultural Statistic

Based on the sample survey in the six barangays in the direct impact area, the average farming household cultivates an average of 1.1 hectares. Only 40% of the farmland are owner-cultivated. The remaining 60% are tilled by tenants. Although most households in the six barangays worked on land under a single arrangement, some has dual arrangement. Around 37% are strictly owner cultivator and 32% are exclusively tenant. Another 11% are land owners who have tenants to work on their land. 11% cultivate their own land and at the same time work on the other land as tenant. The remaining 9% are owner cultivator and have piece of land being worked by tenants.

In the six barangays, fishing is normally engaged as a supplemental food procurement activity but not a full-time market oriented one. Those who fish engage in the activity at an average rate of seven times per month. Every engagement, they take home an average of 1.7 kg of catch. The Nacoton, Tina, Cura and Padsan Rivers serve as the fishing ground. All the fishing households count on the spear (pana) as their fishing gear while hook and line are used by 57 percent. Others gears used are fish trap and nets.

2.7 Cultural Minorities

The direct impact area and the whole province of Ilocos Norte are dominated by the lowland group ethnologically classified as Ilocano. They constitute about 97% of the population of the direct impact area and the province. The largest non-Ilocano ethnic group in the direct impact area and the province are the Tagalog. They constitute about 1% of the respective total population. But the Tagalog, like the Ilocano, belongs to the cultural mainstream. Among the cultural minorities, the Isneg is the largest group in the direct impact area and the province. They compose 0.2 % of the population in the direct impact area and 0.5% in the province. The Isneg is considered a subgroup of the entho-linguistic group collectively called Igorot. This group is geographically associated with the Cordillera Region and the Isneg is mostly found in the province of Apayao. Thus, they are also called Apayao. In the direct impact area, they are concentrated in the municipality of Carasi where half of population of 750 persons are Isneg.

Although its name comes from the Ilocano term which means inhabitants of the Tineg River, the Isneg have accepted it to call themselves. Their economy largely relies on slash and burn

farming although they mostly live along rivers. They grow upland rice as their main crop supplemented by root crops and vegetables. Planting begins in February or March when the omen signals the start of cropping season. The omen include the appearance of the red birds (bakawkaw), blooming of the coral tree (tablang) and the shedding off of the leaves of another tree (basikalan). Swidden sites are usually portions of mountain slopes which have been left to fallow for five to seven years. Farming activities are accompanied by several rituals and observance of beliefs. For instance, ashes and herbs are scattered by the tiller behind him as he utters prayers to the spirits before opening the field. Musical instrument is not allowed in the field so as not to attract the birds which will destroy the crop. The women, who usually do the planting, throw few grains in the field at the day before planting and utters prayers to the rats and offer reparation to the spirits. Just before harvest, a supply of betel chew is placed near the farmer s hut for the daily use of the spirits.

The Isneg live together in 15 to 30 families. It is traditionally headed by the headman (mengal). A person becomes a headman based on wealth, courage and knowledge of the local lore. A reputation of being just is also important because he settles disputes as one of his functions. Working together is based on reciprocity. This is strengthened by the kinship system which is reckoned on both sides. The Isneg have their own ancient alphabet containing 12 consonants and three vowels. They are traditionally animist believing in a number of spirits. Ceremonies are performed by the shaman who is a woman. Included among her functions are the distribution of amulets and the treatment of various ailments.

Most present-day Isneg, including those in Carasi, consider themselves Christians. They have been converted to Catholicism or to some Protestant sect particularly during the American regime. Many Isneg are no longer farmers and many have established themselves in various occupations through formal schooling. They have also intensified their economic interaction with the mainstream population and intermarriage is not rare. The mass media have also penetrated the once isolated social system. These social processes worked together to hasten the acculturation of the Isneg and the dilution of the traditional culture. While some Isneg have already turned their back on tradition, many are still staddling between the past and the present.

2.8 Archeological and Historical Sites

Ilocos Norte yielded no stone age remains during the archeological survey done by O.H. Beyer in 1947. However, he identified Late Tang and Early Sung midden dumps. Accidental excavation also yielded Late Sung, Yuan and Early Ming ceramic pieces. But the sites are usually along coastal areas where trade between pre-colonial inhabitants and Chinese merchants must have thrived. No historical site in the direct impact area is registered in the National Historical Institute. But its has fine specimen of Spanish Baroque Churches made of mortar and red bricks. The outstanding ones are the Sarrat Church and the ruins of the old Dingras Church. The use of red bricks for Spanish period churches is architecturally unique to the Northern Luzon because in Southern Luzon and the Visayas, stone bricks were the staple material.

2.9 Health

The leading cause of morbidity in Ilocos Norte is acute respiratory infection with 5,173 cases per 100,000 population in 1995 as shown in the following table. It has been the leading cause of morbidity in the province in the past five years. But the 1995 rate is much lower than the five-year (1990-1994) average which is 11,018 cases per 100,000 population.

Cause	1990-1994 Average	1995
Morbidity		
Acute respiratory infection	11,018	5,173
Injuries	3,806	3,737
Gastrointestinal disorder	2,609	977
Nutritional and vitamin deficiency	1,981	705
Influenza	1,802	635
Anemia	1,638	781
Skin problem	1,105	659
Musculo-skeletal disorder	716	2117
Parasitism	686	-
Hypertensive diseases	441	-
Heart disease	299	282
Mortality		
Heart disease	112	115
Pneumonia	78	79
Cancer	33	27
Hypertensive disease	27	16
Accident	22	16
Pulmonary Tuberculosis	21	25
Degenerative Disease	9	-
Liver Disease	6	6
Septicemia	4	9
Kidney Disease	3	5

Source: Provincial Health Office

Ranked second is injuries where there are 3,736 cases per 100,000 population in 1995. The rate is just slightly lower than the five-year average which is 3736 cases per 100,000 population. Gastrointestinal disorder which may result from drinking unsafe water is third with 977 cases per 100,000. This is a dramatic reduction from the five year average rate of 2,610 cases per 100,000. Other causes of morbidity in the province are nutritional and vitamin deficiency, influenza, anemia, skin problem and musculo-skeletal disorder. At the national level, the three leading causes of morbidity are bronchitis, diarrhea and influenza.

The leading cause of morality in the province is heart disease. There are 115 cases per 100,000 in 1995 or just slightly lower than the five year average of 112 cases per 100,000. Pneumonia follows causing 79 death per 100,000 in 1995 and an average 78 deaths per 100,000 every year in five year period. The third leading cause of mortality is cancer with 27 cases per 100,000 in 1995. The rate is reduced from the five year average of 27 cases per 100,000. At the national level, pneumonia ranks first and heart disease ranks second. The third is pulmonary tuberculosis which ranks sixth in the province. Other leading causes of mortality in the province are cancer, hypertensive disease, accident and pulmonary tuberculosis. No case of endemic disease is recorded in the province.

2.10 Perception and Attitude

To identify the problems in the direct impact area, the respondents in the six barangays were asked to mention three of these problems. Around 92% of all the respondents mentioned at least one problem. There are seven problems which are ranked first. But none is mentioned more frequently than flooding being ranked first by 89 percent. Other problems which are ranked

first are typhoon, irrigation water, crime, gambling, livelihood, health center. Following tables are listed the problems mentioned by the respondents.

Item	Data
Percentage of respondents who mentioned a problem	92%
Percentage of respondents by problem ranked first	
Flood	89
Typhoon	3
Irrigation Water during dry season	3
Others (crime, gambling, livelihood, health center)	5
Total	100%
Percentage of respondents by problem ranked second	
Soil erosion	31
Bad road	21
Destruction of irrigation system	8
Typhoon	8
Flood	8
Others	3
Total	100%
Percentage of respondents by problem ranked third	
Bad road	36
Electricity	32
Destruction of farmland	12
Landslide/ erosion	8
Lack of livelihood	8
Lack of irrigation water	4
Total	100%
Percentage of respondents aware of the project	71%
Percentage of respondents by description of the project	
Dike	39
Dredging	21
Dredging and dike	18
Dam	11
Others	11
Total	100%
Percentage of respondents by source of information	
Barangay officials	36
DPWH	30
Municipal officials	14
Government	9
Others	11
Total	100%
Percentage of respondents who are for the project	100%

Soil erosion, which is a result of flooding, is the most frequently mentioned second ranked problem. It is mentioned by 31 percent. This is followed by bad roads being cited by 21 percent. Flooding still managed to sneak into the second ranked problems being mentioned by 8 percent. Other problems which are ranked second are typhoon and destruction of irrigation system.

Among the third-ranked problem, bad road is the most frequently mentioned. Around 36% of the respondents consider this as problem. This is followed by lack of electricity (32%) and destruction of farmland (12%). The latter is again a result of flood. Other problems mentioned are the lack of irrigation water, lack of livelihood and landslide / erosion.

The awareness of the project among the respondents is quite high at 71%. Although few give a complete description of the project, most correctly mentioned a part of it. Around 39% said its

a dike intended to control flood while 21% said it involves dredging. Some 18% mentioned both as their description of the project. Other description given are dam and reforestation.

The most frequently reported source of information about the project is the barangay officials. They are identified by 36% of the respondents. Another 30% pointed out the DPWH. The municipal officials and the government in general are the ones mentioned by 14% and 9% of the respondents, respectively. All the respondents are for the implementation of the project. Nobody is against it.

2.11 Experience With Flood

Around 90% of the households in the six barangays surveyed experienced the flood in 1996 as shown in the following tables. The flood lasted an average of 3.8 days. The average depth of the flood waters in front of the house of the respondent-household is 0.8 meters. About 52% of the respondents said the flood came on July although 36% gave a wider time frame of July-October. The flood in the six barangays appears to be closely associated with typhoons. Around 40% of the respondents pinpointed it as the cause of flooding. Some 22% consider river overflow as the cause of flood while 21% believe that the river channels are already so filled up with earth that the water naturally scatter itself. Deforestation is also blamed by 9 % for the flood.

Warning against the flood was reportedly issued and reached 75% of the households. Among the households who heard the warning, 92% identified the radio as the source. The barangay officials are credited by 8 percent. The warning is effective in prompting the households into taking a precautionary measure against the flood. A measure was undertaken by 97 %. Around 46% of them collected their household stuff and 21% moved their stuff to a location of higher elevation. Other measures taken were the construction of makeshift dike, transfer of domestic animals to safer areas and the strengthening of the house.

There are very few households who escaped from the damage brought about by the flood. The children were the first to suffer with 62% of the households having at least one child absent from school. The average duration of the absence is 4.3days. The absence is inevitable because roads are damaged by flood and the river is impassable when its water swells. When the water subsides and the roads are opened to traffic, the class room may be damaged.

The farm produce is the next in line with 54% of the households being hit. The flood can wipe out the crops just about to be harvested. This makes farming in the six barangays a big gamble. A damage of the house is being sustained by 47% and the farmland itself by 43 percent. Rocks and gravel covered the farmland and destroyed both the crops and the farm.

Item	Data
Percentage of households experiencing flood 1996	90%
Average No of days of the last flood experienced	3.8
Average depth of food waters in house front at its peak (in meters)	0.8
Percentage of respondents by month flood is experienced	
May - October	36
July	52
August	12
Total	100%
Percentage of respondents by cause identified for flooding	
Typhoon / heavy rainfall	40
River overflow	22
Shallow water channel	21
Deforestation	9
Others	8
Total	100%
Percentage of households who heard flood warning	75%
Percentage of respondents by warning source	
Radio	92
Barangay captain	8
Total	100%
Percentage of households who took precaution	97%
Percentage of households by type of precaution done	
Collected household items	46
Transferred things at higher elevation	21
Constructed a dike	12
Secured the domestic animals	9
Strengthen the house	5
Others	7
Total	100%
Percentage of households affected by flood (multiple response)	
Injury	8
Sickness	25
House damage	47
Furniture damage	18
Appliance damage	11
Vehicle damage	5
Farm land damage	43
Farm produce damage	54
Livestock loss	13
Poultry loss	33
Fishpond loss	1
School absences	62
Work absences	40
Business closure	9

The flood also prevented the working members of 40 % of the households from going to work. The average duration of absence from work is 4 days. Around 33% of the households lost some poultry and 25% had some members of their family being sick. Less percentage of households incurred furniture damage (18%), livestock loss (13%), appliance damage (11%), business closure (9%), injury among its members (8%), vehicle damage (5%) and fishpond loss (1%). The flood had indeed destroyed not only human health but also properties and productivity.